DOCUMENT RESUME

ED 275 553 SE 047 536

TITLE	Elementary Science Supplement to the Syllabus. Level I (Ages 4 through 7).
INSTITUTION	New York State Education Dept., Albany.
PUB DATE	86
NOTE	106p.; Drawings may not reproduce well.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC05 Plus Postage.
DESCRIPTORS	Course Organization; *Elementary School Science; *Enrichment Activities; Experiential Learning; *General Science; Instructional Improvement; Physical Sciences; Primary Education; *Science Activities; Science Education; *Science Instruction; State Curriculum Guides
IDENTIFIERS	*New York

ABSTRACT

Developed to complement existing elementary science programs, the materials in this first volume of New York's Elementary Science Supplement to the Syllabus emphasize a direct experience, hands-on approach for children of ages 4 through 7. Major sections include: (1) guidelines for program activities (explaining the organizational format of the guide); (2) correlating syllabus and program (including a chart which identifies areas in need of supplementary expansion); and (3) program activities (indicating in most cases the syllabus emphasis, problem, concepts, component connection, evaluation strategy, activities, and supplementary information for 4 units, 4 miniunits, and 16 unit starters). These sub-sections focus on topics such as measuring, properties, pets, the moon, rocks, and animal myths. Appendices consist of a policy statement dealing with handicapped students and a syllabus program correlation chart for Level I students (ages 4 through 7). (ML)

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ELEMENTARY SCIENCE SUPPLEMENT TO THE SYLLABUS

Level I

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SCIENCE ATTITUDES
PROBLEM SOLVING
SKILLS
SCIENCE CONTENT

ELEMENTARY SCIENCE SUPPLEMENT TO THE SYLLABUS

Level I
(Ages 4 through 7)

The University of the State of New York
The State Education Department
Albany, New York 12234

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The curriculum defined in this publication supports the State plan for Basic Skills and was printed, in part, with funds from ESEA Title II Basic Skills.

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FOREWORD

Elementary science teachers realize the importance of direct experience, hands-on activities as keys to good science teaching. The activities included in the three volumes of the *Elementary Science Supplement to the Syllabus* are suggested and not mandatory. The volumes are prepared in a format that will enable you to easily add to, or delete from, the contents.

Many elementary science teachers have an extensive personal repertoire of hands-on activities which will complement the syllabus approach. Teachers willing to share their activities with others are urged to make the Bureau of Science Education aware of their willingness to share. In some instances, activities may be incorporated directly for future publications of the volumes. In other instances, the activities may become a high priority for further development or refinement. Development and refinement may be able to receive local financial support through the BOCES CoSer process in some instances.

The Syllabus-Program Correlation Chart correlates the syllabus outcomes with the instructional activities. The correlation chart will also show areas in need of supplementary expansion. Teachers may wish to add their own classroom activities, field trips, multimedia materials, trade books or text materials to the charts, or to blank forms of the charts.

The program activities in the supplement are loose-leaf. This will enable you to easily add to, modify or delete any of the contents.

The Elementary Science Supplements to the Syllabus for Levels II and III are available from the State Education Department upon request.

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GUIDELINES FOR PROGRAM ACTIVITIES

...effective program activities use a problem-solving approach...

PROGRAM CRITERION: Program activities will use a problem-solving approach.

PROGRAM ACTIVITIES are the teacher-planned activities you use with your students to teach them elementary science. These activities can cause students to encounter discrepancies.

The program activities in this publication are organized into units, mini-units, and unit starters. You may use them for example:

- directly as part of your local elementary science program, or
- as supplements to a commercial program.

UNITS focus on a central problem or theme. They require from several days to several weeks to complete. Units contain the greatest amount of lesson plan detail and supplementary information. You can use the format for units as a standard to help you develop your own units from other activities.

MINI-UNITS also focus on a central problem or theme. However, compared with units, they usually require less time to complete (from a few days to a few weeks) and contain less supplementary information and lesson plan detail. The lesson plans are sufficient to give you direction and assistance, but you should expand them into units and fit them to your personal style and the needs of students before you use them.

UNIT STARTERS focus on a problem or question. Use them to stimulate ideas that lead students to a deeper investigation into a problem. Unit starters contain the least amount of lesson plan detail. You may want to develop detailed lesson plans yourself or use the unit starters to help your students construct a complete plan for solving a problem.

Because unit starters can take a wide variety of forms, they could require from a day to several weeks to complete.

New York Energy Education Project

PROGRAM ACTIVITIES

UNITS

Each unit follows a standard format. The format is designed to be simple, informative, and comprehensive. You can use it to construct your own new units locally.

Components of the unit format are explained below and are illustrated by using annotated sample pages.

TITLE and/or **FOCUS QUESTION**

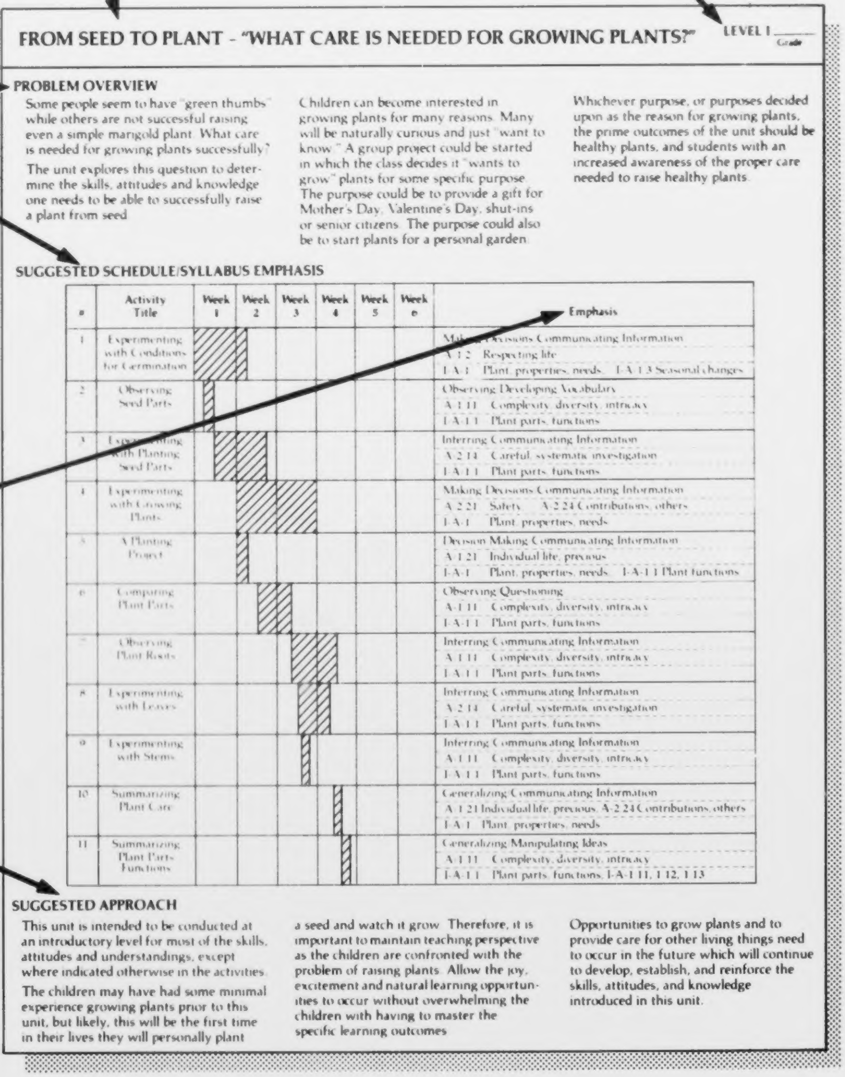
LEVEL indicates the level for which the unit is written. There is space to add the grade at which you will use it.

PROBLEM OVERVIEW provides the setting or context for the problem.

SUGGESTED SCHEDULE lists specific program activities in the recommended sequence for instruction. Time allotments shown are approximate amounts of class time needed to complete the activities.

SYLLABUS EMPHASIS indicates the cross-reference of each activity to the Skills, Science Attitudes, and Science Content sections of the syllabus. It includes only major connections to the syllabus. You may have additional outcomes from your particular activities.

SUGGESTED APPROACH provides an overview of the procedure you might use to conduct the unit.



FROM SEED TO PLANT - "WHAT CARE IS NEEDED FOR GROWING PLANTS?" LEVEL I ____ Grade

PROBLEM OVERVIEW

Some people seem to have "green thumbs" while others are not successful raising even a simple marigold plant. What care is needed for growing plants successfully?

The unit explores this question to determine the skills, attitudes and knowledge one needs to be able to successfully raise a plant from seed.

Children can become interested in growing plants for many reasons. Many will be naturally curious and just "want to know." A group project could be started in which the class decides it "wants to grow" plants for some specific purpose. The purpose could be to provide a gift for Mother's Day, Valentine's Day, shut-ins or senior citizens. The purpose could also be to start plants for a personal garden.

Whichever purpose, or purposes decided upon as the reason for growing plants, the prime outcomes of the unit should be healthy plants, and students with an increased awareness of the proper care needed to raise healthy plants.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Emphasis
1	Experimenting with Conditions for Germination	▨	▨					Making Decisions Communicating Information A-1.2 Respecting life I-A-1 Plant, properties, needs. I-A-1.3 Seasonal changes
2	Observing Seed Parts	▨						Observing Developing Vocabulary A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions
3	Experimenting with Planting Seed Parts	▨	▨					Inferring Communicating Information A-2.14 Careful, systematic investigation I-A-1.1 Plant parts, functions
4	Experimenting with Growing Plants		▨	▨				Making Decisions Communicating Information A-2.21 Safety A-2.24 Contributions, others I-A-1 Plant, properties, needs
5	A Planting Project		▨					Decision Making Communicating Information A-1.21 Individual life, precious I-A-1 Plant, properties, needs. I-A-1.1 Plant functions
6	Comparing Plant Parts		▨	▨				Observing Questioning A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions
7	Observing Plant Roots			▨	▨			Inferring Communicating Information A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions
8	Experimenting with Leaves			▨	▨			Inferring Communicating Information A-2.14 Careful, systematic investigation I-A-1.1 Plant parts, functions
9	Experimenting with Stems			▨				Inferring Communicating Information A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions
10	Summarizing Plant Care				▨			Generalizing Communicating Information A-1.21 Individual life, precious. A-2.24 Contributions, others I-A-1 Plant, properties, needs
11	Summarizing Plant Parts Functions				▨			Generalizing Manipulating Ideas A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions, I-A-1.11, 1.12, 1.13

SUGGESTED APPROACH

This unit is intended to be conducted at an introductory level for most of the skills, attitudes and understandings, except where indicated otherwise in the activities.

The children may have had some minimal experience growing plants prior to this unit, but likely, this will be the first time in their lives they will personally plant a seed and watch it grow. Therefore, it is important to maintain teaching perspective as the children are confronted with the problem of raising plants. Allow the joy, excitement and natural learning opportunities to occur without overwhelming the children with having to master the specific learning outcomes.

Opportunities to grow plants and to provide care for other living things need to occur in the future which will continue to develop, establish, and reinforce the skills, attitudes, and knowledge introduced in this unit.

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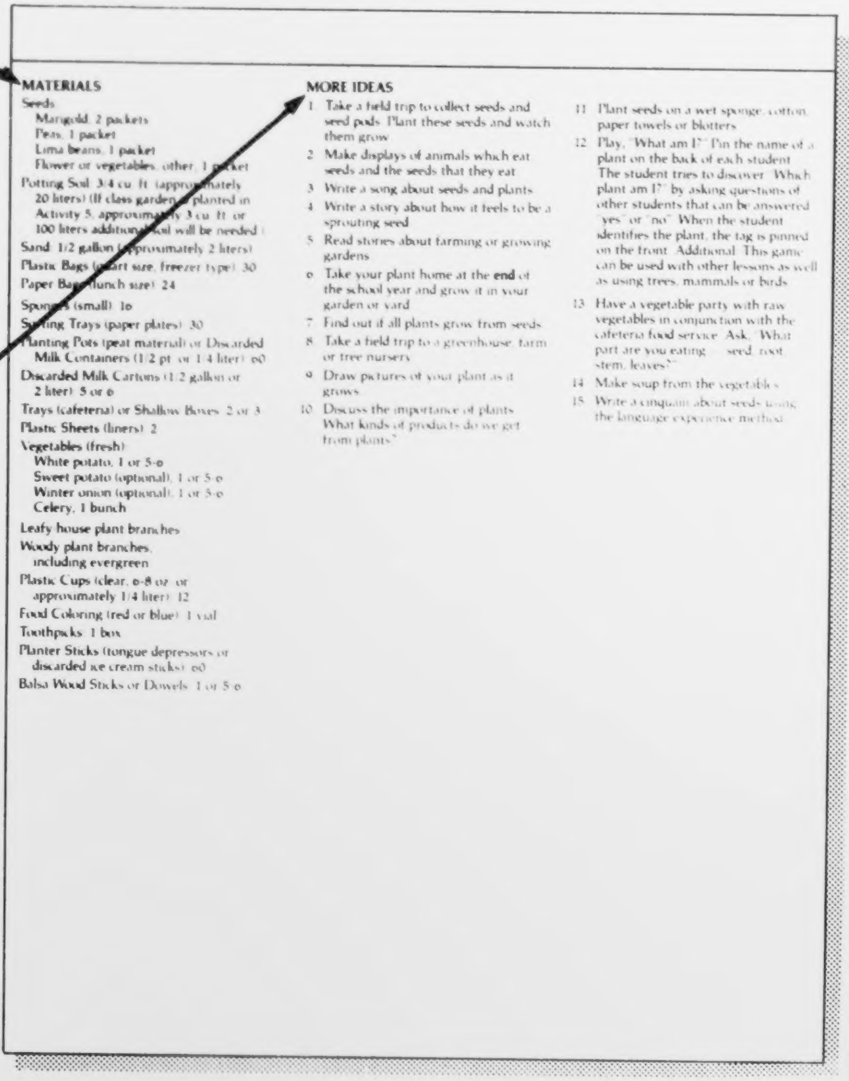
UNITS

MATERIALS are listed for the entire unit. Quantities shown are for class-size groups.

MORE IDEAS list other activities that you can use at your discretion to:

- extend the unit,
- enrich the unit, or
- reinforce learning outcomes.



MATERIALS

Seeds
  Marigold, 2 packets
  Peas, 1 packet
  Lima beans, 1 packet
  Flower or vegetables, other, 1 packet
Potting Soil: 3/4 cu. ft. (approximately 20 liters) (If class garden is planted in Activity 5, approximately 3 cu. ft. or 100 liters additional soil will be needed.)
Sand: 1/2 gallon (approximately 2 liters)
Plastic Bags (quart size, freezer type): 30
Paper Bags (lunch size): 24
Sponges (small): 16
Sprouting Trays (paper plates): 30
Planting Pots (peat material) or Discarded Milk Containers (1/2 pt. or 1/4 liter): 60
Discarded Milk Cartons (1/2 gallon or 2 liter): 5 or 6
Trays (cafeteria) or Shallow Boxes: 2 or 3
Plastic Sheets (liners): 2
Vegetables (fresh)
  White potato, 1 or 5-6
  Sweet potato (optional), 1 or 5-6
  Winter onion (optional), 1 or 5-6
  Celery, 1 bunch
Leafy house plant branches
Woody plant branches, including evergreen
Plastic Cups (clear, 6-8 oz. or approximately 1/4 liter): 12
Food Coloring (red or blue): 1 vial
Toothpicks: 1 box
Planter Sticks (tongue depressors or discarded ice cream sticks): 60
Balsa Wood Sticks or Dowels: 1 or 5-6

MORE IDEAS

1. Take a field trip to collect seeds and seed pods. Plant these seeds and watch them grow.
2. Make displays of animals which eat seeds and the seeds that they eat.
3. Write a song about seeds and plants.
4. Write a story about how it feels to be a sprouting seed.
5. Read stories about farming or growing gardens.
6. Take your plant home at the **end** of the school year and grow it in your garden or yard.
7. Find out if all plants grow from seeds.
8. Take a field trip to a greenhouse, farm or tree nursery.
9. Draw pictures of your plant as it grows.
10. Discuss the importance of plants. What kinds of products do we get from plants?
11. Plant seeds on a wet sponge, cotton, paper towels or blotters.
12. Play, "What am I?" Pin the name of a plant on the back of each student. The student tries to discover "Which plant am I?" by asking questions of other students that can be answered "yes" or "no". When the student identifies the plant, the tag is pinned on the front. Additional: This game can be used with other lessons as well as using trees, mammals or birds.
13. Have a vegetable party with raw vegetables in conjunction with the cafeteria food service. Ask, "What part are you eating — seed, root, stem, leaves?"
14. Make soup from the vegetables.
15. Write a cinquain about seeds using the language experience method.

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PROGRAM ACTIVITIES

SUPPLEMENTARY INFORMATION gives you additional information. It can include a materials list, safety notes, procedural notes, references to more ideas, preparation notes, and ways to integrate the activities with other areas such as art, music, and social studies.

ACTIVITIES provide directions for conducting the activity.

SYLLABUS EMPHASIS shows the connection between the activity and the syllabus.

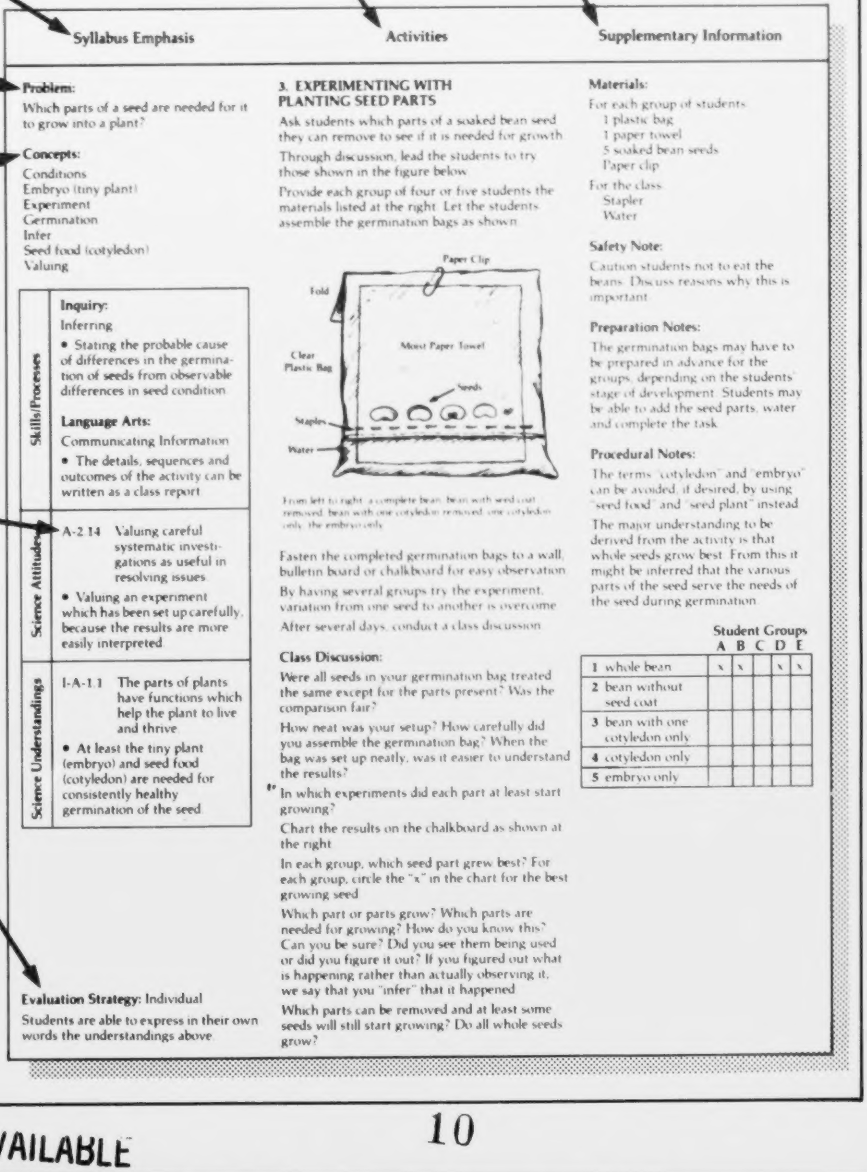
PROBLEM states the problem in the form of a question that focuses inquiry.

CONCEPTS provide words that are symbolic of the main concepts dealt with in the activity. These key words are mainly for your own use. Therefore, you will need to decide your own students' readiness to use the words and the level at which you would expect your students to use them. For example, you might not use the word with them at all, or you might require only that they know how to spell it.

COMPONENT CONNECTION lists the major skills, science attitudes, and science principles that the activity brings together. It is a minimum cross-reference to the syllabus. You may wish to add other cross-references.

EVALUATION STRATEGY suggests a behavioral outcome for the activity and indicates the kind of evaluation you should make. The recommended kinds of evaluation are:

- Individual – evaluate each student,
- Group – base your evaluation on samplings of groups of students, and
- Program – evaluate the effectiveness of the activity by using either individual students or student groups.



Syllabus Emphasis

Problem:

Which parts of a seed are needed for it to grow into a plant?

Concepts:

Conditions
Embryo (tiny plant)
Experiment
Germination
Infer
Seed food (cotyledon)
Valuing

Skills/Processes	**Inquiry:** Inferring • Stating the probable cause of differences in the germination of seeds from observable differences in seed condition **Language Arts:** Communicating Information • The details, sequences and outcomes of the activity can be written as a class report
Science Attitudes	A-2.14 Valuing careful systematic investigations as useful in resolving issues • Valuing an experiment which has been set up carefully, because the results are more easily interpreted
Science Understandings	I-A-1.1 The parts of plants have functions which help the plant to live and thrive • At least the tiny plant (embryo) and seed food (cotyledon) are needed for consistently healthy germination of the seed

Evaluation Strategy: Individual

Students are able to express in their own words the understandings above

Activities

3. EXPERIMENTING WITH PLANTING SEED PARTS

Ask students which parts of a soaked bean seed they can remove to see if it is needed for growth

Through discussion, lead the students to try those shown in the figure below

Provide each group of four or five students the materials listed at the right. Let the students assemble the germination bags as shown

From left to right: a complete bean, bean with seed coat removed, bean with one cotyledon removed, one cotyledon only, the embryo only

Fasten the completed germination bags to a wall, bulletin board or chalkboard for easy observation

By having several groups try the experiment, variation from one seed to another is overcome

After several days, conduct a class discussion

Class Discussion:

Were all seeds in your germination bag treated the same except for the parts present? Was the comparison fair?

How neat was your setup? How carefully did you assemble the germination bag? When the bag was set up neatly, was it easier to understand the results?

In which experiments did each part at least start growing?

Chart the results on the chalkboard as shown at the right

In each group, which seed part grew best? For each group, circle the "x" in the chart for the best growing seed

Which part or parts grow? Which parts are needed for growing? How do you know this? Can you be sure? Did you see them being used or did you figure it out? If you figured out what is happening rather than actually observing it, we say that you "infer" that it happened

Which parts can be removed and at least some seeds will still start growing? Do all whole seeds grow?

Supplementary Information

Materials:

For each group of students
  1 plastic bag
  1 paper towel
  5 soaked bean seeds
  Paper clip

For the class
  Stapler
  Water

Safety Note:

Caution students not to eat the beans. Discuss reasons why this is important

Preparation Notes:

The germination bags may have to be prepared in advance for the groups, depending on the students' stage of development. Students may be able to add the seed parts, water and complete the task

Procedural Notes:

The terms "cotyledon" and "embryo" can be avoided, if desired, by using "seed food" and "seed plant" instead

The major understanding to be derived from the activity is that whole seeds grow best. From this it might be inferred that the various parts of the seed serve the needs of the seed during germination

	Student Groups A	B	C	D	E
1 whole bean	x	x		x	x
2 bean without seed coat					
3 bean with one cotyledon only					
4 cotyledon only					
5 embryo only					

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Schenectady Community Headstart Program

PROGRAM ACTIVITIES

MINI-UNITS

Each mini-unit follows a standard format. The format is intended to be simple and informative but less comprehensive than the unit format. You can use it to construct your own new mini-units locally.

Components of the mini-unit format are explained below and are illustrated by using annotated sample pages.

TITLE and/or **FOCUS QUESTIONS**

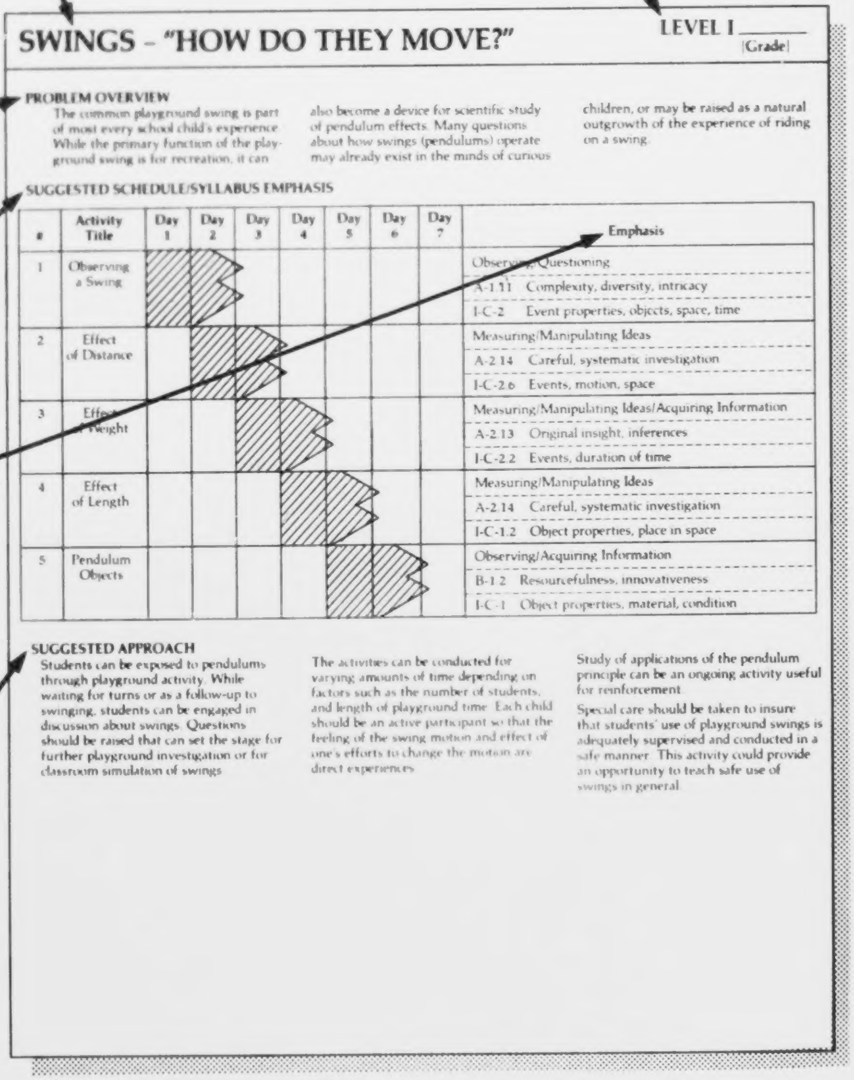
LEVEL indicates the level for which the mini-unit is written. There is space to add the grade at which you will use it.

PROBLEM OVERVIEW provides the setting or context for the problem.

SUGGESTED SCHEDULE lists specific program activities in the recommended sequence for instruction. Time allotments shown are approximate amounts of class time needed to complete the activities.

SYLLABUS EMPHASIS indicates the cross-reference of each activity to the Skills, Science Attitudes, and Science Content sections of the syllabus. It includes only major connections to the syllabus. You may have additional outcomes from your particular activities.

SUGGESTED APPROACH provides an overview of the procedure you might use to conduct the mini-unit.



SWINGS - "HOW DO THEY MOVE?"

LEVEL I ______
(Grade)

PROBLEM OVERVIEW

The common playground swing is part of most every school child's experience. While the primary function of the playground swing is for recreation, it can also become a device for scientific study of pendulum effects. Many questions about how swings (pendulums) operate may already exist in the minds of curious children, or may be raised as a natural outgrowth of the experience of riding on a swing.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Emphasis
1	Observing a Swing	▨	▨						Observing/Questioning A-1.11 Complexity, diversity, intricacy I-C-2 Event properties, objects, space, time
2	Effect of Distance		▨	▨					Measuring/Manipulating Ideas A-2.14 Careful, systematic investigation I-C-2.6 Events, motion, space
3	Effect of Weight			▨	▨				Measuring/Manipulating Ideas/Acquiring Information A-2.13 Original insight, inferences I-C-2.2 Events, duration of time
4	Effect of Length				▨	▨			Measuring/Manipulating Ideas A-2.14 Careful, systematic investigation I-C-1.2 Object properties, place in space
5	Pendulum Objects					▨	▨		Observing/Acquiring Information B-1.2 Resourcefulness, innovativeness I-C-1 Object properties, material, condition

SUGGESTED APPROACH

Students can be exposed to pendulums through playground activity. While waiting for turns or as a follow-up to swinging, students can be engaged in discussion about swings. Questions should be raised that can set the stage for further playground investigation or for classroom simulation of swings.

The activities can be conducted for varying amounts of time depending on factors such as the number of students, and length of playground time. Each child should be an active participant so that the feeling of the swing motion and effect of one's efforts to change the motion are direct experiences.

Study of applications of the pendulum principle can be an ongoing activity useful for reinforcement.

Special care should be taken to insure that students' use of playground swings is adequately supervised and conducted in a safe manner. This activity could provide an opportunity to teach safe use of swings in general.

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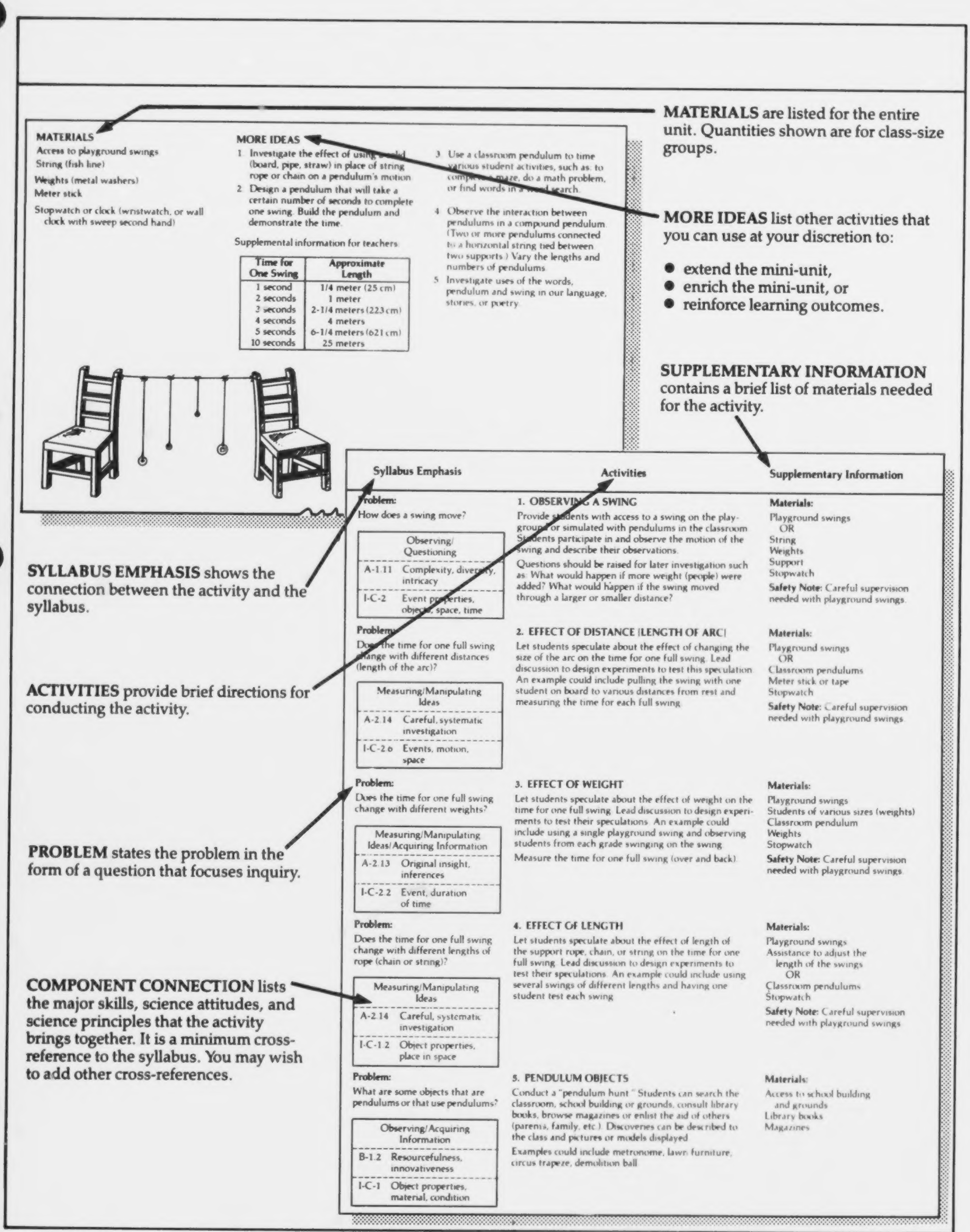

MATERIALS

Access to playground swings

String (fish line)

Weights (metal washers)

Meter stick

Stopwatch or clock (wristwatch, or wall clock with sweep second hand)

MORE IDEAS

1. Investigate the effect of using a solid (board, pipe, straw) in place of string rope or chain on a pendulum's motion
2. Design a pendulum that will take a certain number of seconds to complete one swing. Build the pendulum and demonstrate the time.
3. Use a classroom pendulum to time various student activities, such as: to complete a maze, do a math problem, or find words in a word search.
4. Observe the interaction between pendulums in a compound pendulum. (Two or more pendulums connected to a horizontal string tied between two supports.) Vary the lengths and numbers of pendulums.
5. Investigate uses of the words, pendulum and swing in our language, stories, or poetry.

Supplemental information for teachers:

Time for One Swing	Approximate Length
1 second	1/4 meter (25 cm)
2 seconds	1 meter
3 seconds	2-1/4 meters (223 cm)
4 seconds	4 meters
5 seconds	6-1/4 meters (621 cm)
10 seconds	25 meters

MATERIALS are listed for the entire unit. Quantities shown are for class-size groups.

MORE IDEAS list other activities that you can use at your discretion to:

- extend the mini-unit,
- enrich the mini-unit, or
- reinforce learning outcomes.

SUPPLEMENTARY INFORMATION contains a brief list of materials needed for the activity.

Syllabus Emphasis | **Activities** | **Supplementary Information**

Problem:
How does a swing move?

Observing/ Questioning	
A-1.11	Complexity, diversity, intricacy
I-C-2	Event properties, objects, space, time

1. OBSERVING A SWING

Provide students with access to a swing on the playground or simulated with pendulums in the classroom. Students participate in and observe the motion of the swing and describe their observations.

Questions should be raised for later investigation such as: What would happen if more weight (people) were added? What would happen if the swing moved through a larger or smaller distance?

Materials:
Playground swings
OR
String
Weights
Support
Stopwatch

Safety Note: Careful supervision needed with playground swings.

Problem:
Does the time for one full swing change with different distances (length of the arc)?

Measuring/Manipulating Ideas	
A-2.14	Careful, systematic investigation
I-C-2.6	Events, motion, space

2. EFFECT OF DISTANCE (LENGTH OF ARC)

Let students speculate about the effect of changing the size of the arc on the time for one full swing. Lead discussion to design experiments to test this speculation. An example could include pulling the swing with one student on board to various distances from rest and measuring the time for each full swing.

Materials:
Playground swings
OR
Classroom pendulums
Meter stick or tape
Stopwatch

Safety Note: Careful supervision needed with playground swings.

Problem:
Does the time for one full swing change with different weights?

Measuring/Manipulating Ideas/Acquiring Information	
A-2.13	Original insight, inferences
I-C-2.2	Event, duration of time

3. EFFECT OF WEIGHT

Let students speculate about the effect of weight on the time for one full swing. Lead discussion to design experiments to test their speculations. An example could include using a single playground swing and observing students from each grade swinging on the swing.

Measure the time for one full swing (over and back).

Materials:
Playground swings
Students of various sizes (weights)
Classroom pendulum
Weights
Stopwatch

Safety Note: Careful supervision needed with playground swings.

Problem:
Does the time for one full swing change with different lengths of rope (chain or string)?

Measuring/Manipulating Ideas	
A-2.14	Careful, systematic investigation
I-C-1.2	Object properties, place in space

4. EFFECT OF LENGTH

Let students speculate about the effect of length of the support rope, chain, or string on the time for one full swing. Lead discussion to design experiments to test their speculations. An example could include using several swings of different lengths and having one student test each swing.

Materials:
Playground swings
Assistance to adjust the length of the swings
OR
Classroom pendulums
Stopwatch

Safety Note: Careful supervision needed with playground swings.

Problem:
What are some objects that are pendulums or that use pendulums?

Observing/Acquiring Information	
B-1.2	Resourcefulness, innovativeness
I-C-1	Object properties, material, condition

5. PENDULUM OBJECTS

Conduct a "pendulum hunt." Students can search the classroom, school building or grounds, consult library books, browse magazines or enlist the aid of others (parents, family, etc.). Discoveries can be described to the class and pictures or models displayed.

Examples could include metronome, lawn furniture, circus trapeze, demolition ball.

Materials:
Access to school building and grounds
Library books
Magazines

SYLLABUS EMPHASIS shows the connection between the activity and the syllabus.

ACTIVITIES provide brief directions for conducting the activity.

PROBLEM states the problem in the form of a question that focuses inquiry.

COMPONENT CONNECTION lists the major skills, science attitudes, and science principles that the activity brings together. It is a minimum cross-reference to the syllabus. You may wish to add other cross-references.

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PROGRAM ACTIVITIES

UNIT STARTERS

UNIT STARTERS

Each unit starter follows a standard format. The format is designed to be brief, yet it contains enough information to stimulate many ideas for activities. You can use it to construct your own new unit starters locally.

Components of the unit starter format are explained below and are illustrated by using an annotated sample page.

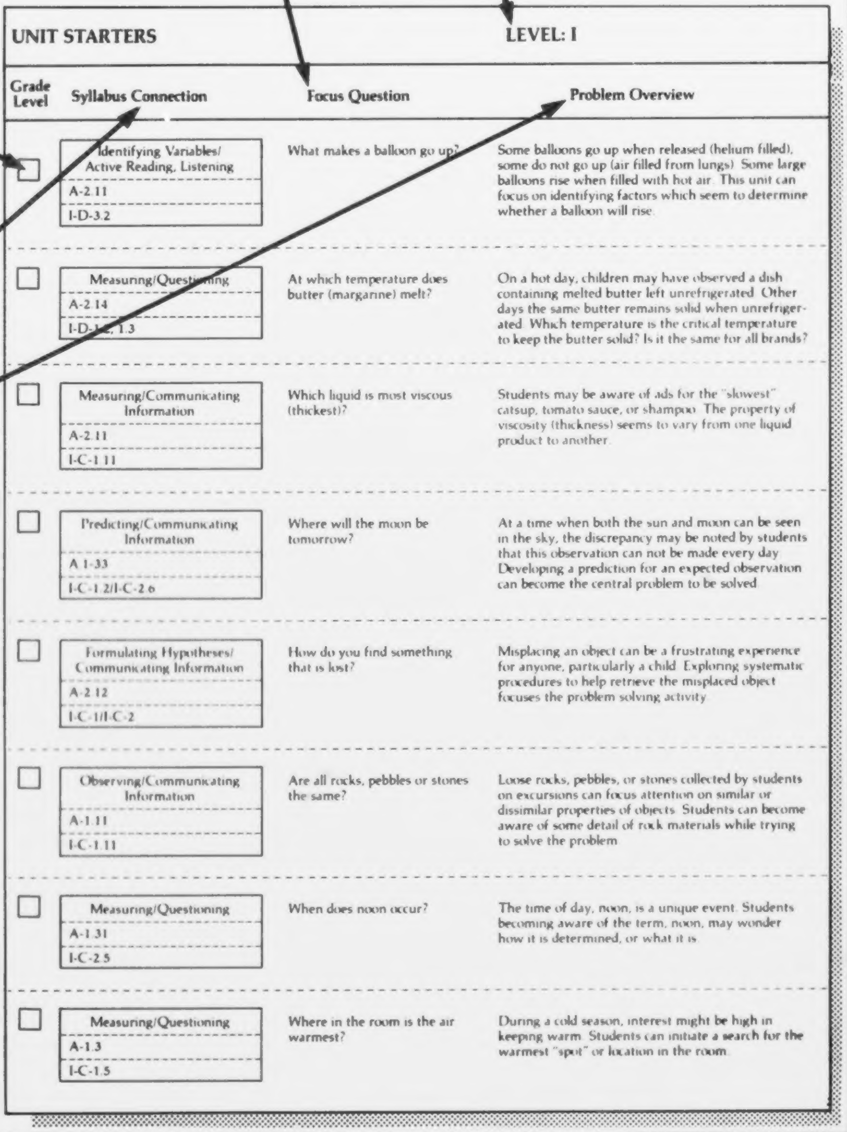
FOCUS QUESTION represents the discrepancy underlying the problem and is presented in the form of a question.

LEVEL indicates the level for which the unit starter is written.

GRADE provides space for you to add the grade at which you will use it.

SYLLABUS CONNECTION contains a brief cross-reference of the activity to the Skills, Science Attitudes, and Science Content sections of the syllabus.

PROBLEM OVERVIEW provides the context in which the discrepancy can be encountered and the focus question identified.



UNIT STARTERS

LEVEL: I

Grade Level	Syllabus Connection	Focus Question	Problem Overview
☐	Identifying Variables/ Active Reading, Listening A-2.11 I-D-3.2	What makes a balloon go up?	Some balloons go up when released (helium filled), some do not go up (air filled from lungs). Some large balloons rise when filled with hot air. This unit can focus on identifying factors which seem to determine whether a balloon will rise.
☐	Measuring/Questioning A-2.14 I-D-1.2, 1.3	At which temperature does butter (margarine) melt?	On a hot day, children may have observed a dish containing melted butter left unrefrigerated. Other days the same butter remains solid when unrefrigerated. Which temperature is the critical temperature to keep the butter solid? Is it the same for all brands?
☐	Measuring/Communicating Information A-2.11 I-C-1.11	Which liquid is most viscous (thickest)?	Students may be aware of ads for the "slowest" catsup, tomato sauce, or shampoo. The property of viscosity (thickness) seems to vary from one liquid product to another.
☐	Predicting/Communicating Information A 1-33 I-C-1.2/I-C-2.6	Where will the moon be tomorrow?	At a time when both the sun and moon can be seen in the sky, the discrepancy may be noted by students that this observation can not be made every day. Developing a prediction for an expected observation can become the central problem to be solved.
☐	Formulating Hypotheses/ Communicating Information A-2.12 I-C-1/I-C-2	How do you find something that is lost?	Misplacing an object can be a frustrating experience for anyone, particularly a child. Exploring systematic procedures to help retrieve the misplaced object focuses the problem solving activity.
☐	Observing/Communicating Information A-1.11 I-C-1.11	Are all rocks, pebbles or stones the same?	Loose rocks, pebbles, or stones collected by students on excursions can focus attention on similar or dissimilar properties of objects. Students can become aware of some detail of rock materials while trying to solve the problem.
☐	Measuring/Questioning A-1.31 I-C-2.5	When does noon occur?	The time of day, noon, is a unique event. Students becoming aware of the term, noon, may wonder how it is determined, or what it is.
☐	Measuring/Questioning A-1.3 I-C-1.5	Where in the room is the air warmest?	During a cold season, interest might be high in keeping warm. Students can initiate a search for the warmest "spot" or location in the room.

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CORRELATING SYLLABUS AND PROGRAM

...appropriate problem-solving activities always correlate directly to the syllabus.

PROGRAM CRITERION: Program activities should always correlate directly to the skills, science attitudes, and science content defined in the syllabus.

The syllabus tells you what the State expects you to teach in elementary science. The Syllabus-Program Correlation Chart shows you which program activities you can use to teach a particular part of the syllabus.

An activity correlates to the syllabus if its expected outcome is the same as a desired outcome defined in the syllabus. Thus, in the illustration below, the program activity on "trees" correlates to the syllabus in that it teaches the skill of "questioning," the science attitude of "respect," and the science content of "seed dispersal."

You can use the Syllabus-Program Correlation Chart both with program activities you design yourself and with those you take from other sources. Once you have filled in the chart, you can use it to:

- provide a quick inventory of all program activities available,
- select appropriate program activities that will achieve specific syllabus outcomes, and
- determine which outcomes each program activity is expected to achieve.

You can also use the Syllabus-Program Correlation Chart:

- as a worksheet to determine the correlation to the syllabus of other instructional materials such as kits, field trips, media materials, trade books, and texts
- as an organizing sheet to help you develop a local sequence of instruction for each grade or each special grouping of students
- as an analysis sheet to help you answer such questions as:
  - — Are we teaching everything we should be teaching?
  - — Are we needlessly duplicating instruction between grades or levels?
  - — Are we providing enough reinforcement of outcomes within a grade or within a level?

SYLLABUS	ACTIVITY	BUOYANCY	TREES	CLOUDS	STREAM FIELD TRIP	MOVIE: MAPLE TREES	TEXT: CHAPTER 3				
SKILLS	CLASSIFYING			■							
	MEASURING				■						
	QUESTIONING	■	■				■				
	COMMUNICATING			■		■					
SCIENCE ATTITUDES	RESPECT		■			■	■				
	SAFETY				■						
	TRUTHFUL REPORTING	■									
	SERVICE						■				
SCIENCE CONTENT	MATERIAL SHAPE	■									
	ENERGY FORM			■	■						
	SEED DISPERSAL		■				■				
	STORED FOOD					■					

Blank correlation charts are included in Appendix G of the syllabus and in Appendix B of this publication. Wall-chart-size versions of the charts are also available from the State Education Department upon request.

SYLLABUS - PROGRAM CORRELATION CHART
LEVEL I - UNITS and MINI-UNITS

		UNIT								MINI-UNIT							
	ACTIVITIES	PROPERTIES	MEASURING	FROM SEED TO PLANT	GROWING OLDER					SWINGS	MYSTERY COLORS	PETS	EARTHWORMS				
	Time Emphasis (Days)																
INQUIRY SKILLS	CLASSIFYING	■	■														
	CREATING MODELS				■												
	FORMULATING HYPOTHESES				■												
	GENERALIZING	■		■	■							■	■				
	IDENTIFYING VARIABLES											■					
	INFERRING	■		■	■							■	■				
	INTERPRETING DATA	■			■							■	■				
	MAKING DECISIONS	■		■													
	MANIPULATING MATERIALS	■	■								■						
	MEASURING		■							■	■						
	OBSERVING	■		■	■					■		■	■				
	PREDICTING	■															
	RECORDING DATA	■			■						■	■					
	REPLICATING				■						■						
	USING NUMBERS		■														
LANGUAGE ARTS SKILLS/ PROCESSES	CLASSIFYING																
	DEVELOPING VOCABULARY	■		■													
	MANIPULATING IDEAS	■	■	■	■					■		■	■				
	QUESTIONING	■		■	■					■							
	RECORDING DATA										■						
	USING CUES																
	ACQUIRING INFORMATION	■			■					■			■				
	COMMUNICATING INFORMATION	■	■	■	■						■	■	■				
SCIENCE ATTITUDES	A. APPRECIATING, ENJOYING, NATURE																
	1. UNDERSTANDING, NATURAL WORLD																
	1.1 APPRECIATING NATURAL WORLD			■								■					
	1.11 COMPLEXITY, DIVERSITY, INTRICACY, ETC.			■	■					■			■				
	1.12 RESOURCE, HUMAN NEEDS																
	1.2 RESPECTING LIFE			■								■					
	1.21 INDIVIDUAL LIFE, PRECIOUS			■													
	1.22 SOURCE FOR CONTINUATION																
	1.23 AGING PROCESS				■												
	1.3 WANTING TO KNOW, UNDERSTAND																
	1.31 CONCEPTS, TERMS, TECHNIQUES, ETC.		■														
	1.32 ACCURATE INFORMATION												■				
	1.33 EXPLANATIONS, INTERPRETATIONS, PREDICTIONS												■				
	2. INVESTIGATIVE METHODS, NATURAL WORLD																
	2.1 SKEPTICISM, INVESTIGATION, REASONING	■															
	2.11 UNCERTAINTY OF INFORMATION, VERIFICATION																
	2.12 AMBIGUITY, CONTRADICTION, TENTATIVENESS	■															
	2.13 ORIGINAL INSIGHT, INFERENCES, ETC.	■								■							
	2.14 CAREFUL, SYSTEMATIC INVESTIGATION	■		■	■					■	■		■				
	2.15 LOGICAL REASONING, VALIDITY OF IDEAS	■															
	2.2 RESPECTING OTHERS, ENVIRONMENT	■															
	2.21 SAFETY	■	■	■								■					
	2.22 USE OF RESOURCES		■														
	2.23 CONTRIBUTING FAIR SHARE OF EFFORT												■				
	2.24 CONTRIBUTIONS, OTHERS	■	■	■													
	2.25 TRUTHFUL REPORTING		■								■		■				
	2.26 BELIEFS AND VALUES OF OTHERS																
	B. VALUING USE OF KNOWLEDGE FOR SOCIETY																
	1. THE PRACTICAL, TECHNICAL																
	1.1 SCIENTIFIC TECHNIQUES, MATERIALS										■						
	1.2 RESOURCEFULNESS, INNOVATIVENESS		■							■							
	1.3 TECHNIQUE EFFICIENCY, SIMPLICITY, ETC.	■									■						
	2. SERVICE THROUGH TECHNOLOGY																
	2.1 NEEDS, PROBLEMS OF OTHERS											■					
	2.2 BENEFITS OF TECHNOLOGICAL CHANGE				■												
	2.3 POTENTIAL ADVERSE CONSEQUENCES																

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LIFE SCIENCE (LEVEL I)	I. NATURAL WORLD																
	IA. PLANTS, ANIMALS, NEEDS											■					
	1. PLANTS, PROPERTIES, NEEDS			■													
	1.1 PLANT PARTS, FUNCTIONS			■													
	1.11 ROOTS			■													
	1.12 LEAVES			■													
	1.13 STEMS, STALKS, TRUNKS, ETC.																
	1.2 PLANT PARTS, IMMEDIATE NEEDS																
	1.3 PLANT PARTS, SEASONAL CHANGES			■													
	1.4 PLANT GROWTH AND DEVELOPMENT, LIFE SPAN				■												
	1.41 SEED, SEEDLING, MATURE PLANT				■												
	1.42 BULB, YOUNG PLANT, MATURE PLANT																
	1.43 LENGTH OF LIFE SPAN				■												
	1.5 PLANT PART VARIATIONS																
	2. ANIMALS, PROPERTIES, NEEDS												■				
	2.1 ANIMAL PARTS, FUNCTIONS												■				
	2.11 WINGS, LEGS, FINS											■					
	2.12 MOUTH, TEETH, JAWS, TONGUE											■					
	2.13 NOSTRIL											■					
	2.14 EYES, NOSE, EAR, TONGUE, SKIN																
	2.15 CLAWS, SHELLS, ETC.																
	2.16 BODY COVERING																
	2.17 PARTS, SOUND																
	2.2 ANIMAL PARTS, IMMEDIATE NEEDS											■					
	2.3 ANIMAL PARTS, SEASONAL NEEDS																
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	2.5 ANIMALS, CONTROL CONDITIONS, NEEDS											■	■				
	2.6 ANIMALS, MOTION, NEEDS																
	2.7 ANIMAL PART VARIATIONS																
	IB. PLANTS, ANIMALS, DEPENDENCY				■							■	■				
	1. ANIMALS — PLANTS												■				
	2. PLANTS — ANIMALS																
	3. ANIMALS — ANIMALS																
PHYSICAL SCIENCE (LEVEL I)	IC. OBJECTS, EVENTS, PROPERTIES	■	■								■						
	1. OBJECT PROPERTIES, MATERIAL, CONDITION	■	■							■							
	1.1 OBJECT PROPERTIES, MATERIAL	■															
	1.11 DIFFERENT MATERIALS/PROPERTIES	■															
	1.12 CHANGING SIZE, SHAPE																
	1.13 SOLID, LIQUID, GAS																
	1.14 MIXTURES										■						
	1.2 OBJECT PROPERTIES, LOCATION IN SPACE									■							
	1.3 OBJECT PROPERTIES, AMOUNT OF SPACE	■	■														
	1.4 TWO OBJECTS, SAME SPACE																
	1.5 OBJECT PROPERTIES, SURROUNDING CONDITIONS		■														
	2. EVENT PROPERTIES, OBJECTS, SPACE, TIME									■							
	2.1 EVENT, TIME, PLACE IN SPACE																
	2.2 EVENT, DURATION OF TIME		■							■							
	2.3 EVENTS, SEQUENCE, ORDER, SPACE										■						
	2.4 TWO EVENTS, TIME																
	2.5 REPEATING EVENTS, INTERVALS OF TIME																
	2.6 EVENTS, MOTION, SPACE									■							
	ID. INTERACTION, OBJECTS, EVENTS																
	1. OBJECTS -- HEAT																
	1.1 HEATING, COOLING, WARMER, COLDER																
	1.2 HEATING MATERIALS, LIQUIDS, GASES																
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	1.4 HEATING, COOLING, VOLUME CHANGE																
	2. OBJECT, MOTION, PUSH-PULL																
	2.1 DIRECTION OF PUSH-PULL, CHANGE IN MOTION																
	2.2 SIZE OF PUSH-PULL, OBJECT MASSIVENESS, MOTION																
	2.3 SURFACE CONDITION, SIZE OF PUSH-PULL, MOTION																
	3. OBJECTS, SUPPORTED BY OBJECTS																
	3.1 UNIFORM BALANCE BEAM	■	■														
	3.11 TWO OBJECTS, EQUAL WEIGHT, BALANCE POINT																
	3.12 TWO OBJECTS, DIFF. WEIGHT, BALANCE POINT																
	3.2 OBJECTS, FLOATING, SINKING	■															

SYLLABUS - PROGRAM CORRELATION CHART
LEVEL I - UNIT STARTERS

	ACTIVITIES	RISING BALLOONS	MELTING BUTTER	VISCOUS LIQUIDS	POSITION OF THE MOON	LOST OBJECTS	ROCKS AND PEBBLES	HIGH NOON	HOT SPOTS	SWIMMING FISH	PUMPKIN SEEDS	LOOK-ALIKE LEAVES	ANIMAL APPEARANCES	PEOPLE AND PLANTS	BIRD FOOD	FOOD FROM SEEDS	ANIMAL MYTHS
		UNIT STARTERS															
	Time Emphasis (Days)																
INQUIRY SKILLS	CLASSIFYING																
	CREATING MODELS																
	FORMULATING HYPOTHESES					■							■				
	GENERALIZING													■			■
	IDENTIFYING VARIABLES	■															
	INFERRING														■		
	INTERPRETING DATA															■	
	MAKING DECISIONS																
	MANIPULATING MATERIALS																
	MEASURING		■	■				■	■								
	OBSERVING						■			■		■					
	PREDICTING				■												
	RECORDING DATA																
	REPLICATING																
	USING NUMBERS										■						
LANGUAGE ARTS SKILLS/ PROCESSES	CLASSIFYING																
	DEVELOPING VOCABULARY																
	MANIPULATING IDEAS																
	QUESTIONING		■					■	■		■	■	■		■		
	RECORDING DATA																■
	USING CUES															■	
	ACQUIRING INFORMATION	■												■			
	COMMUNICATING INFORMATION			■	■	■	■			■							
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	2.12 AMBIGUITY, CONTRADICTION, TENTATIVENESS				■	■											
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	2.3 POTENTIAL ADVERSE CONSEQUENCES																

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LIFE SCIENCE (LEVEL I)	I. NATURAL WORLD																
	IA. PLANTS, ANIMALS, NEEDS																
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	1.12 LEAVES																
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	2. ANIMALS, PROPERTIES, NEEDS																■
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	IB. PLANTS, ANIMALS, DEPENDENCY														■		
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	3. ANIMALS — ANIMALS																
PHYSICAL SCIENCE (LEVEL I)	IC. OBJECTS, EVENTS, PROPERTIES					■											
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	1.12 CHANGING SIZE, SHAPE																
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	1.14 MIXTURES																
	1.2 OBJECT PROPERTIES, LOCATION IN SPACE		■		■												
	1.3 OBJECT PROPERTIES, AMOUNT OF SPACE		■									■					
	1.4 TWO OBJECTS, SAME SPACE																
	1.5 OBJECT PROPERTIES, SURROUNDING CONDITIONS								■								
	2. EVENT PROPERTIES, OBJECTS, SPACE, TIME					■											
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	2.2 EVENT, DURATION OF TIME																
	2.3 EVENTS, SEQUENCE, ORDER, SPACE																
	2.4 TWO EVENTS, TIME																
	2.5 REPEATING EVENTS, INTERVALS OF TIME							■									
	2.6 EVENTS, MOTION, SPACE				■												
	ID. INTERACTION, OBJECTS, EVENTS																
	1. OBJECTS — HEAT																
	1.1 HEATING, COOLING, WARMER, COLDER																
	1.2 HEATING MATERIALS, LIQUIDS, GASES																
	1.3 COOLING MATERIAL, LIQUIDS, SOLIDS																
	1.4 HEATING, COOLING, VOLUME CHANGE																
	2. OBJECT, MOTION, PUSH-PULL																
	2.1 DIRECTION OF PUSH-PULL, CHANGE IN MOTION																
	2.2 SIZE OF PUSH-PULL, OBJECT MASSIVENESS, MOTION																
	2.3 SURFACE CONDITION, SIZE OF PUSH-PULL, MOTION																
	3. OBJECTS, SUPPORTED BY OBJECTS																
	3.1 UNIFORM BALANCE BEAM																
	3.11 TWO OBJECTS, EQUAL WEIGHT, BALANCE POINT																
	3.12 TWO OBJECTS, DIFF. WEIGHT, BALANCE POINT																
	3.2 OBJECTS, FLOATING, SINKING	■															

Elmira City School System

I

PROPERTIES

“WHICH ONE IS LIKE THE OTHER?”

PROPERTIES "WHICH ONE IS LIKE THE OTHER?"

LEVEL I ________
(GRADE)

PROBLEM OVERVIEW

A child is confronted daily with problems that have to do with matching things. Socks, shoes, boots, crayons, game pieces, and toys are examples of some objects that frequently require sorting in order to become useful. Many children become interested in collecting things which usually require organizing. As children grow older, they will be faced with other matching problems such as matching missing buttons on clothing, finding covers to fit containers in the kitchen, or finding more of a certain nail in the workshop. This unit uses common problems such as these as a means to establish a "need to know;" to develop the skills of problem solving; to learn about some properties of objects such as color, shape, size, texture, and weight that are useful to know in order to solve this type and similar types of problems; and to develop attitudes that will foster effective problem solving. As a result of the experiences gained in this unit, the child should be better able to solve the problem that is characterized by the question, "Which one is like the other?"

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Emphasis
1	Finding a Matching Button	▨						Observing/Developing Vocabulary A-2.21 Safety; A-2.24 Contributions, others I-C-1.11 Different materials, different properties
2	Planning a Way To Solve a Problem	▨						Classifying/Questioning A-2.14 Careful, systematic investigation I-C-1.1 Object properties, material
3	Testing the Plan	▨						Classifying/Communication Information A-2.14 Careful, systematic investigation I-C-1.1 Object properties, material
4	Organizing a Collection of Objects		▨					Generalizing/Communicating Information A-2.13 Original insight, inferences, etc. I-C-1.1 Object, properties, material
5	Shapes of Objects		▨					Manipulating, Replication/Active Listening A-2.2 Respecting others, environment I-C-1.3 Object properties, amount of space
6	Using Properties To Identify an "Unknown" Object			▨				Interpreting Data/Questioning A-2.1 Skepticism, investigation, reasoning I-C-1 Object properties, material, condition
7	Weights of Objects			▨	▨			Manipulation/Questioning A-2.21 Safety; B-1.3 Technique efficiency, simplicity I-D-3.1 Uniform balance beam
8	Floating and Sinking Objects				▨			Predicting/Communicating Information A-2.21 Safety I-D-3.2 Objects, floating, sinking
9	Kinds of Materials					▨	▨	Inferring/Communicating Information A-2.12 Ambiquity, contradiction, tentativeness I-C-1 Object properties, material, condition
10	Summarizing Object Properties						▨	Generalizing/Developing Vocabulary, Manipulating Ideas A-2.24 Contributions, others I-C-1.11 Different materials, different properties
11	Summarizing The Process of Matching Objects						▨	Making Decisions/Manipulating Ideas A-2.15 Logical reasoning, validity of ideas I-C Objects, events, properties

SUGGESTED APPROACH

This unit may take about 30 class periods to complete but can be shortened or extended to match the readiness and interest of the students. However, great care should be taken to provide ample time for activities and the repetition of experiences to insure that adequate reinforcement of learning takes place. The habit of paying attention to details needs to be developed. Planning activities in the unit can be emphasized or subdued according to the teacher's judgment of the readiness of the students for the activities. Teachers may have the opportunity to provide instruction to students with handicapping conditions. When such students are appropriately placed in these classes, instructional techniques and materials must be modified to the extent appropriate to provide the opportunity to attain the objectives. The planning part of the problem-solving process is intended to be introduced at this level, but will be developed in more detail in later levels.

MATERIALS

Several pieces of clothing with a button missing (one piece per four students, preferably all pieces different)

1 button collection (This should consist of a large, mixed assortment of buttons, including several of each kind; about 30-50 buttons will be needed for each student group. Each collection should contain one matching button for each item of clothing.)

1 object collection (In each collection, include 15 objects such as crayons, marbles, shells, balloons, plastic spoons, buttons, corks, rubber bands, and styrofoam packing insulation. Use one collection per five-member group.)

30 paper bags, lunch size

2 plastic bags, small

1 set Tangram cards

10 sets small Tangram pieces

1 set metal, wood, plastic pieces, uniform in size and shape

1 set large display pieces of several kinds of material: wood, plastic, metal, etc.

15 sorting trays

15 four-liter pans for water

1 box Geometrical Tile Blocks

1 box Geometrical Solid Blocks

1 double-pan balance and lump of modeling clay

chart paper (newsprint)

paper towels

30 common objects from home or school; e.g., orange, hard-boiled egg, potato, pebbles, apple, yarn, sandpaper, piece of wood, comb, chalk, crayon, sponge, etc.

modeling clay

labels

MORE IDEAS

1. Make a bulletin board display or classroom display of some type of collection – stamps, shells, leaves, coins, rocks, fossils, etc.
2. Have students draw pictures that use only circles, triangles, diamonds.
3. Have students place newsprint over objects of different texture and make rubbings with crayon, chalk, or charcoal. Objects could include coins, bricks, floor, pieces of wood, bark, stones, concrete, gravestones (cemetery visit).
4. Have students make a list of things around the classroom or home that need to be organized, with many and varied ways of organizing them.
5. Make jigsaw puzzles available for students to solve.
6. Conduct a "Pretty Button" contest. Students bring in from home or select from buttons available a button they think is pretty. Feelings can be shared about why the buttons are pretty. Properties or characteristics that are appreciated can be described.
7. Have students collect fall leaves and determine: Which one is like the other? Are any two alike? How many different kinds are there?
8. Make a display of objects having a property in common. Have a contest in which students are asked what the property is.
9. Have students make puppets to illustrate a story. Sort buttons to obtain matching ones for eyes, ears, etc.
10. Visit a store with the class to observe how objects in the store have been organized. Have students make their own store.
11. Have students sort objects on the basis of living or nonliving, made from something that was living or made from something that was nonliving.
12. Art activity – Observe seeds to note properties, use the seeds to create a picture. (Seeds with different properties are used to fill in parts of the picture.)
13. Make a list of many and varied uses for objects such as buttons other than their original intended use.

Problem:

Which one is like the other?

Concepts:

color	property
cooperate	safety
group	shape
listen	share
match	size

Skills/Processes	**Inquiry:** Observing • Students use their senses to make direct observations of the objects (buttons). **Language Arts:** Developing Vocabulary • Words used to describe properties are identified and directly associated with the property.
Science Attitudes	A-2.21 Valuing the use of investigative procedures that limit the risk to one's self, others, or the living and nonliving environment. A-2.24 Respecting the contributions of others to the solution of a problem. • Listening carefully and respectfully while others speak can help us obtain information to help solve a problem. • Accepting the ideas and efforts of a handicapped person in group problem solving.
Science Understandings	I-C-1.11 Different kinds of materials have different properties. • Buttons (or other objects) have properties such as color, texture, and weight.

Evaluation Strategy:

Program

The students are able to recognize a problem to be solved in trying to match a button (or other object).

1. FINDING A MATCHING BUTTON (OR OTHER OBJECT).

Give each group of four students a piece of clothing lacking a button. Explain that we need to have a matching button and that we each will have an assortment of buttons to use.

Establish rules for safety. (See Safety Note.)

Provide students with a collection of buttons and let them try to find a matching button from their collection. After three or four groups have found a matching button (or after a few minutes), stop the activity.

Let some groups describe what they did while trying to find the matching button. An example of a successful try might include: "Our buttons are red. So we looked for all of the red buttons and found this one." Write their examples on the chalkboard and use key words, i.e., "looked for red buttons."

An example of an unsuccessful try might include: "Our buttons are small. We kept looking for one like them, but we had to stop before we found one." Write unsuccessful examples on board also.

Class Discussion:

Which words in the list describe your buttons? (Examples: red, flat, small, round, two holes, shiny, etc.)

Which words describe how to find buttons? (Examples: look, feel, compare, group, pile, etc.)

Summarize the "button" words into as many as five main groups on a property word chart as shown at the right. List one sample "button" word under each group. Explain that these words describe properties of objects. Write other words on the property word chart that students suggest belong under other groups.

Summarize the "finding" words into groups on another word chart as shown at the right. List one sample "finding" word under each group in a similar manner. Explain that these words are "how to" words for part of the problem-solving process.

Raise a question for the children to think about as the lead-in to the next activity. What is the best way to solve a problem like matching a button?

Materials:

Several pieces of clothing with a button missing
Button collection, class size
Sorting trays
Chart paper
(Other objects could be substituted for clothing or buttons.)

Safety Note:

Safety rules should be discussed for using buttons. Students should identify the rules they feel are important. For example:

1) Don't put buttons in your mouth, nose, ears, or eyes.

2) Be careful to keep buttons in the tray on the desk.

Property Words

Color Words	Size Words
yellow silver	large tiny
Shape Words	**Weight Words**
oval rectangular	heavy light
Texture Words	
smooth bumpy	

Problem-solving Process Words

Obtaining Information	Organizing Information
look feel	group pile
Analyzing Information	
compare	

Procedural Note:

When developing the word charts, list only words derived from the students' discussion. For example, do not use additional color words, texture words, or "finding" words if they have not been mentioned. These words should be added in the following activities.

When students with visual impairments or fine motor difficulties are participating, the buttons should have unique tactile characteristics or should be large.

SYLLABUS EMPHASIS | **ACTIVITIES** | **SUPPLEMENTARY INFORMATION**

Problem:

What is the best way to match a button (or other object)?

Concepts:

group
plan
property
questions
share

Skills/Processes	**Inquiry:** Classifying • Questions are raised and grouped to aid in problem solving. **Language Arts:** Questioning • Students are stimulated to think of questions that when answered will help solve a problem.
Science Attitudes	A-2.14 Valuing careful, systematic investigation as useful in resolving issues. • Careful planning is an important first step in conducting an investigation.
Science Understandings	I-C-1.1 Some properties of an object are dependent upon the materials from which the object is made. • Students have an opportunity to connect the need for knowledge about properties of objects with the problem of matching buttons (or other objects).

Evaluation Strategy:

Group
Program

The students are able to describe questions needed for a plan. The class is able to identify specific questions for a plan to find a matching button.

2. PLANNING A WAY TO SOLVE A PROBLEM.

Explain that to solve a problem, most of the time a plan is needed.

In order to create a plan, we need to raise certain kinds of questions. Then we can search for their answers.

Class Discussion:

1. What is the problem? How can we find another button (or object) to match the ones we have? Do we know the best way to find the matching button (or object)?

Depending on the students' success in finding a matching button in the previous activity, they may have various opinions about the quality of their plans. Instruction based on teacher questioning from this point should build on what the students already know. The purpose here is *raising* questions to be answered, not answering them.

2. What do we already know? What are the properties of the button?

3. What do we need to know? Which buttons have a property like the button we have?

4. How can we find what we need to know? How can we group the buttons? Which property of the button is best for finding a matching one? Do we need to use more than one property to find a matching button?

5. How will we know when we have solved the problem? What rules will help guide us in deciding whether a button matches ones we have?

As questions are identified, they can be written on chart paper to serve as a continuing guide for the activities that follow. See examples at the right.

Materials:

Chart paper

PLANNING QUESTIONS

1. What is the problem?

How can we find another button to match the ones we have?

2. What do we already know?

What are the properties of the button?
What is the shape of the button?
What is the color of the button?

3. What do we need to know?

Which buttons have a property like the button we have? (round, red, flat, three holes, etc.)

4. How can we find out?

What different groups can we put the buttons into by color?
What different groups can we put the buttons into by the number of holes?
What different groups can we put the buttons into by the color and number of holes?

5. How will we know when we have solved the problem?

How can we decide whether a button matches ones we have?

Procedural Note:

It may be useful to extend the discussion by considering the question, "If you were handicapped, how would your plan need to be changed?"

SYLLABUS EMPHASIS

Problem:

How well does the plan work?

Concepts:

compare
method
plan
property
questions
share

Skills/Processes	**Inquiry:** Classifying • The buttons (or other objects) are sorted according to a plan for solving the problem. **Language Arts:** Communicating Information • Results from testing the plan can be shared through group discussion.
Science Attitudes	A-2.14 Valuing careful systematic investigation as useful in resolving issues. • Marveling at the success of matching buttons (or other objects) when a plan is used. A-2.24 Respecting the contributions of others to the solution of a problem. • Listening to the ideas of others in solving problems.
Science Understandings	I-C-1.1 Some properties of an object are dependent upon the materials from which the object is made. • Some buttons (or other objects) are different from others because they have different properties.

Evaluation Strategy:

Individual

Students are able to match a given button (or other object) using a collection that contains a matching button (or other object).

ACTIVITIES

3. TESTING THE PLAN.

The students should try again to find a matching button, using the plan devised in the previous activity. If pairs were successful before, they should try a different piece of clothing.

After the plan has been tested and the students have been successful in matching the button, conduct a discussion about their results.

Class Discussion:

What questions were you trying to answer? Were there other questions that could have or should have been used? How successful was the plan?

As new words are mentioned, they can be added to the appropriate word charts.

Students should eventually recognize that other questions could have been asked such as "What is the shape of the button?" These new questions could be added to the question chart as subquestions.

The students should continue seeking answers to the questions in the plan, revising the plan as needed, looking for new information (about the buttons in the collection) by sorting the buttons and counting the numbers in each group.

Mathematical comparisons of the button groups can be made using symbols such as >, <, or = .

The activity can be concluded by discussing the following problem question:
What would be the best way to organize a collection of buttons in order to find a button faster the next time we need a button?

Students can describe methods they have devised. Every method should be supported with reasons why the student feels it is the "best."

SUPPLEMENTARY INFORMATION

Materials:

Several pieces of clothing with a missing button
Button collection
Sorting trays

Procedural Note:

Creativity should be encouraged. Many methods can be used to organize the buttons.

SYLLABUS EMPHASIS

Problem:

What is the best way to organize a collection of objects?

Concepts:

compare
cooperate
method
organize
plan
property
sort

Skills/Processes	**Inquiry:** Generalizing • Statements can be made summarizing the basis for organizing collections of objects. **Language Arts:** Communicating Information • Statements made orally by, written for, or tape recorded by the students can be generated to describe the basis for organizing collections of objects.
Science Attitudes	A-2.13 Valuing original insights, uncertain inferences, and flexible and unconventional thinking as sources of potentially useful ideas. • Accepting unusual bases for organizing collections of objects.
Science Understandings	I-C-1.1 Some properties of an object are dependent upon the materials from which the object is made. • Objects may have unique properties that distinguish them from each other.

Evaluation Strategy:

Group

Students are able to describe several different ways to organize a collection of objects based on the properties of the object.

ACTIVITIES

4. ORGANIZING A COLLECTION OF OBJECTS.

Provide each pair of students with an object collection and a sorting tray. When grouping students into pairs it is important to consider individual student needs. Pairs can be used efficiently to assist students with special needs and enhance particular strengths of other students.

Students should use the experience of the previous activities to decide how to solve this problem. Questions should be raised as before about information known, information needed, and procedure to follow.

Each pair should organize their collection and then let the other members of the class try to determine the basis (properties) that they used to organize the objects. This can be conducted like a game.

New property words for objects or "finding" words or new questions should be shared and added to the charts.

Class Discussion:

How many different ways can a collection of objects be organized?

From the discussion of different bases for organizing objects, students may think of other ways not tried. Each new way should include the properties of the objects that would be used as the basis.

SUPPLEMENTARY INFORMATION

Materials:

Object collection
Sorting trays
Word charts

Procedural Note:

It may be desirable to repeat this type of activity several times to reinforce the new learnings developed up to this point in the unit. Care must be taken to insure that students have an accurate perception of the concepts behind these learnings and are paying adequate attention to detail in their application of the learnings to problem solving.

More Ideas:

Numbers 1 and 7 may add to the interest and motivation for this activity.

SYLLABUS EMPHASIS

Problem:

What is the shape of the object?

Concepts:

- carefulness
- cooperate
- neatness
- property
- rectangle
- rhombus (diamond)
- shapes
- share
- square
- triangle

Skills/Processes	**Inquiry:** Manipulating Replicating • Students create concrete shapes or replicate shapes made by others. **Language Arts:** Active Listening • As descriptions and experiences are shared by students, they listen carefully for details.
Science Attitudes	A-2.2 Respecting others and the environment in pursuing study of the natural world. • Working in small group learning centers requires respect for and cooperation with others.
Science Understandings	I-C-1.3 The space occupied by an object is determined by the properties of the object. • Objects have distinctive shapes.

Evaluation Strategy:

Individual

Students are able to match various shaped objects in the room with the shape words listed on the property word list.

ACTIVITIES

5. SHAPES OF OBJECTS.

From previous activities, students have learned that shape is one property that can be used to describe objects.

Explain to students that they will be able to visit each of three learning centers. At each center they can make something that will result in different shapes being formed.

Set up the three learning centers in the classroom as follows:

1. Geometrical Solid Blocks – Suggest to the students that they construct buildings, roads, towers, etc. They may bring in small cars or other toys to complement their construction.
2. Geometrical Tile Blocks – Suggest to the students that they create designs and patterns for other students to replicate.
3. Tangrams – Suggest to the students that they use four pieces only to solve all the puzzles. (Point out one small square, two small triangles, and one rhombus [diamond] as the pieces.)

Allow the students to circulate between the centers for at least three consecutive days during science time.

At the end of each "lesson," have the students share their experiences. Add new shape words to the property word chart. Draw the shape next to the word.
(□ = square)

SUPPLEMENTARY INFORMATION

Materials:

Geometrical Solid Blocks
Geometrical Tile Blocks
Tangram cards
Tangram pieces, 10 sets
Word charts from previous activities

Procedural Note:

1) This activity takes a minimum of three lessons. It is desirable for students to have access to the materials during other free periods throughout the day. Learning centers should be maintained until interest wanes.

2) Additional centers with similar materials may be set up to accommodate smaller groups.

3) Students can draw pictures of some of the shapes they have created as an infusion of art. Students who are unable to draw should be able to demonstrate their skills and knowledge through other means such as creating models using clay or orally presenting information.

More Ideas:

See numbers 2 and 5 on page 17.

SYLLABUS EMPHASIS

Problem:

What's in the bag?

Concepts:

feel
hard
listen
properties
rough
share
smooth
soft
texture
touch

Skills/Processes	**Inquiry:** Interpreting Data • Information gathered about the unknown object is interpreted in the game. **Language Arts:** Questioning • Students have opportunities to raise questions in an effort to solve the problem.
Science Attitudes	A-2.1 Valuing skepticism, careful investigation, and logical reasoning as means of increasing one's understanding of the natural world. • Students can consider the dilemma of rushing to conclusions versus moving skeptically and logically, as it relates to the game. A-2.24 Respecting the contributions of others to the solution of a problem. • Listening to the ideas of others in solving problems.
Science Understandings	I-C-1 The properties of an object are determined by its material and condition. • Properties of "hidden" objects are determined as part of the game.

Evaluation Strategy:

Group

Students are able to identify common objects based on the described properties of the object.

ACTIVITIES

6. USING PROPERTIES TO IDENTIFY AN "UNKNOWN" OBJECT.

Play the following game. Distribute a large paper bag containing a single object to each student.

Ask the students to identify properties of their object without taking the object out of the bag and without showing the object to other students. Each student should write the properties of their object on the outside of the bag. Words may be copied from the word charts.

After the students have completed identifying properties of their own objects, turns can be taken by each to read the properties of their object to the class. The class then tries to identify the object. "Is it an egg?" etc.

If the objects are not identified, suggestions from the class can be made about looking for new properties. "Does it feel rough?" "Is it heavy?" etc. New words should be added to the charts. As the objects are identified, each student may then show the object to the class. The properties of the object should be confirmed by the student.

Class Discussion: (optional)

Why is it important in an investigation to wait until all of the properties are known before we identify the object?

This question could become a focal point if students indicate a desire to "rush" to conclusions about the identity of the object. Reasons could be listed for waiting, or discuss consequences of error if one is not "willing to suspend judgment."

SUPPLEMENTARY INFORMATION

Materials:

Common objects from home or school such as: orange, hard-boiled egg, potato, apple, pebbles, yarn, sandpaper, piece of wood, comb, chalk, crayon, sponge, etc.

Paper bags

Word charts from previous activity

Procedural Note:

This game may be run like a "20 Questions" game. The student only answers "yes" or "no" to questions about the unknown object. If someone identifies the object correctly, he/she becomes "it" for a new object.

Color, shape, and size may be reviewed at this time. New words for these properties may be added to the word charts.

New properties such as weight or texture may be identified as "new problems." For example, "How could we find the weight of an object?" or "Which of the objects is heavier?"

SYLLABUS EMPHASIS | **ACTIVITIES** | **SUPPLEMENTARY INFORMATION**

Problem:

Which object (of the crayons, etc.) is heaviest?

Concepts:

balance	property
heavy	weigh
light	weight

Skills/Processes	**Inquiry:** Manipulating • Students gain experience in manipulating a balance as part of the method to solve the problem. **Language Arts:** Questioning • Students raise questions or are helped to raise questions to use in solving the problem.
Science Attitudes	A-2.21 Valuing the use of investigative procedures that limit the risk to one's self, others, or the living and nonliving environment. B-1.3 Caring about efficiency, simplicity, and dependability of techniques. • Accepting that good techniques with equipment such as a balance can result in more success in solving problems.
Science Understandings	I-D-3.1 Objects on a uniform balance beam may or may not be in balance, depending on the location of the support. • Students become aware of the physical principles of balances.

Evaluation Strategy:

Individual

Students are able to determine the relative weight of several objects using a balance and arrange them in order according to weight.

7. WEIGHTS OF OBJECTS.

In previous activities, the property of weight may have been mentioned. Students may have been satisfied merely to pick up an object and declare that it is "heavy" or "light" or that one object is "heavier" than another.

But if we can't be certain which object is heavier by lifting it, what can we do?

Give students several common objects that are apparently alike such as crayons, pencils, pieces of chalk, bean seeds, paper clips, buttons, etc.

Class Discussion:

Students should make a plan for solving this problem. It may be helpful for students to recall experiences they have had in which something was weighed. These experiences can be recorded on an experience chart.

A balance or scale is used as a means to determine which is heavier.

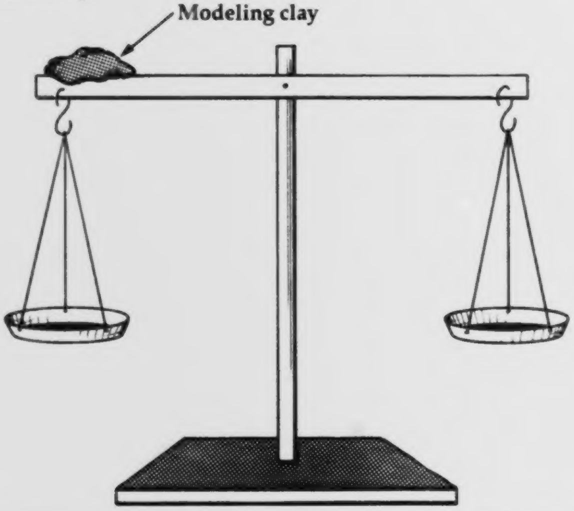
Show the students a double-pan balance. Demonstrate that a balance is used to compare the property of weight of two different objects. The heavier object will pull harder on its side of the balance.

Provide each pair of students with access to a balance and allow them to proceed with the problem solving for the question.

New questions may occur to students to investigate such as: Which objects are heavier than a crayon, pencil, etc.?

Can we organize the objects (crayons, etc.)by weight from heaviest to lightest? Can we organize different objects by weight?

New words can be added to the word charts at the end of the activity.



Materials:

Collection of objects (common objects from home such as crayons, pencils, paper clips, chalk, erasers, beans, etc.)

Double-pan balance

Lump of modeling clay

Word charts from previous activities

Preparation:

Assemble balance or balances as shown in the illustration. Use a lump of clay on one end of the balance arm to balance the empty pans initially, if needed.

Safety Note:

Students should be aware of safety rules when using small objects.

Procedural Note:

It may be useful to extend the activity to deal with attitudes such as A-2.24.

SYLLABUS EMPHASIS

Problem:

Which objects float and which ones sink?

Concepts:

float
predict
sink

Skills/Processes	**Inquiry:** Predicting • Students use prior experience to predict outcomes of floating and sinking. **Language Arts:** Communicating Information • Predictions are shared with others orally.
Science Attitudes	A-2.21 Valuing the use of investigative procedures that limit the risk to one's self, others, or the living and nonliving environment. • Recognizing the potential problem that would be caused by careless use of water in the investigation and taking care to use appropriate procedures.
Science Understandings	I-D-3.2 Some objects fall through a liquid (sink) while others are supported by it (float). • Some common objects may float in water; others may sink.

Evaluation Strategy:

Group

Students are able to sort objects and make a collection of "floaters" or "sinkers" based on the results of testing their predictions. .

ACTIVITIES

8. FLOATING AND SINKING OBJECTS. Show students a container of water with some objects floating and some on the bottom as shown below.

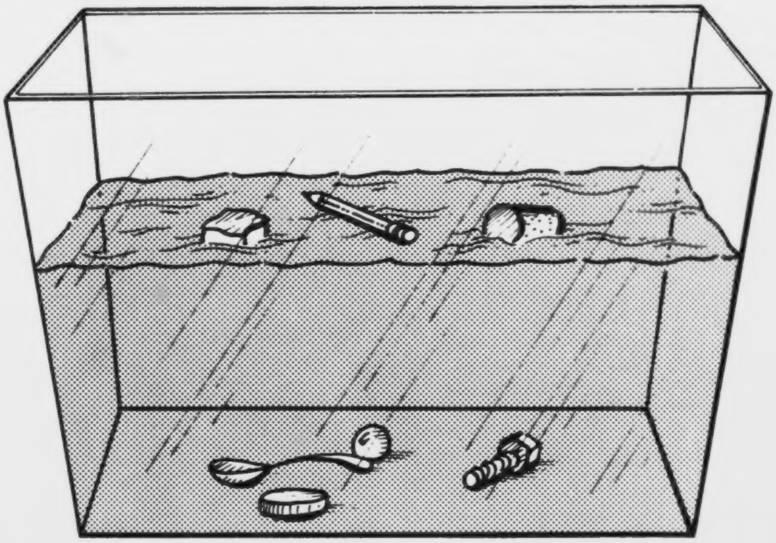
From the demonstration, students should realize that some objects float and some sink. Which common objects are alike in that they float? Which ones are alike in that they sink?

After planning how to solve this problem, students should predict whether objects will float or sink before testing them.

Have students give reasons for their predictions. These can be listed on a chalkboard.

Allow students to test their predictions, using a collection of common objects from home or the classroom.

After predictions have been tested, add new words or questions to the word charts.



SUPPLEMENTARY INFORMATION

Materials:

Containers, approximately four-liter capacity
Objects from home or classroom
Paper towels
Words charts from previous activities

Caution:

Do not use objects that will be damaged by water.

It may be necessary to air-dry some objects overnight before they can be used in the activity again.

Art Infusion:

Have the students draw a picture similar to the one above showing which objects floated and which sank.

Safety Note:

Students should be made aware of the danger of putting objects in toilets or in playing near open bodies of water such as ponds, rivers, or swimming pools.

Procedural Note:

It may be useful to extend the activity to deal with attitudes such as A-2.24.

SYLLABUS EMPHASIS **ACTIVITIES** **SUPPLEMENTARY INFORMATION**

Problem:

How are (these) objects different?

Concepts:

material
metal
plan
plastic
property
rubber
weight
wood

Skills/Processes	**Inquiry:** Inferring • Students make statements about the probable composition of materials based on their observations. **Language Arts:** Communicating Information • Students have an opportunity to present the outcomes of the activity to each other orally.
Science Attitudes	A-2.12 Welcoming the unknown or the ambiguous and accepting contradictory or tentative ideas as starting points for increasing one's understanding of the natural world. • Becoming quickly involved in trying to resolve discrepancies in observations of the objects which look alike but are different.
Science Understandings	I-C-1 The properties of an object are determined by its material and condition. • Objects which look alike may be different because of other observable properties.

Evaluation Strategy:

Group

Students are able to identify differences in properties of objects with the same shape and size and identify other objects made of similar material.

9. KINDS OF MATERIALS.

Show students samples of materials that are alike in size and shape. The similarity of the objects should be obvious.

The problem question poses the opposite kind of problem to the unit title question. In this case students are looking for differences.

Students should discuss and devise plans for solving the problem.

Additional questions relating to new information that might be considered and suggested to the students are: Which objects float (or sink) in water? Which objects around the room (school) or at home seem to be made of the same material (as one of the samples)? What common objects seem to contain more than one kind of these materials?

Make materials available as needed to enable the students to implement their plans.

Class Discussion:

New words or questions that arose as part of the plans or as a result of investigating can be added to the word charts. It may be helpful to start a new word chart for materials as shown at the right.

Questions that can be discussed to conclude the activity are: How were the objects alike? How were the objects different? Which properties of the objects were most helpful in answering the first two questions?

Materials:

Samples such as aluminum, steel, brass, plastic (clear acrylic), mahogany, balsa, pine, and oak. (All samples must have the same size and shape.)
Large samples of aluminum, steel, brass, plastic, and wood
Common objects from home or classroom
Balances (double pan)
Water container
Labels for wood, plastic, etc.
Word charts from previous activities

Sample Word Chart

wood:	metal:
brown	hard
tan	shiny
grainy	plastic:
hard	flexible
	hard

SYLLABUS EMPHASIS

Problem:

What is the best way to identify objects?

Concepts:

differences
identify
listen
objects
properties
share
similarity

Skills/Processes	**Inquiry:** Generalizing • Students summarize their experiences by making statements about object properties. **Language Arts:** Developing Vocabulary Manipulating Ideas • Concise statements are prepared that summarize the properties of objects.
Science Attitudes	A-2.24 Respecting the contributions of others to the solution of a problem. • Listening attentively to others during discussions of the activity.
Science Understandings	I-C-1.11 Different kinds of materials have different properties. • Objects observed in the various activities are composed of different materials which give the objects different properties.

Evaluation Strategy:

Group

Students are able to summarize the outcomes about object properties in the form of concise statements.

ACTIVITIES

10. SUMMARIZING OBJECT PROPERTIES.

Class Discussion:

Review briefly by having students recall:

- Activity 1 in which students examined buttons and described their appearance.
- Activity 4 in which students looked for ways to group many objects based on their appearance.
- Activities 5, 7, 8, and 9 in which specific properties of objects were studied.
- Activity 6 in which a game was played that required using property names to identify objects.

Prepare a chart on the chalkboard or chart paper that summarizes some of the properties objects can have. Ask students to supply the properties from their recall or from word charts constructed in earlier activities.

Conclude the discussion with thought questions: Are there likely to be other properties of objects which we have not listed? How could these properties be identified?

SUPPLEMENTARY INFORMATION

Materials:

Results from Activities 1, 4, 5, 6, 7, 8, and 9.

SYLLABUS EMPHASIS **ACTIVITIES** **SUPPLEMENTARY INFORMATION**

Problem:

What is the best way to match objects?

Concepts:

classify
group
listen
plan
properties
questions
share
sort

Skills/Processes	**Inquiry:** Making Decisions • Students weigh the methods used throughout the activities to decide which seems best. **Language Arts:** Manipulating Ideas • Concise statements are made that summarize choices made for the best methods to match objects.
Science Attitudes	A-2.15 Valuing logical reasoning as a means of testing and weighing the validity of ideas. • Realizing that the solution of problems is best approached by logical reasoning.
Science Understandings	I-C Objects and events have distinctive properties. • Problem solving is an event which has distinctive properties.

Evaluation Strategy:

Group

Students are able to express and justify their choices for steps in solving the matching problem in the form of concise statements.

11. SUMMARIZING THE PROCESS OF MATCHING OBJECTS.

Class Discussion:

Review briefly by having students recall:

- Activity 2 in which students discussed successful and unsuccessful methods for matching buttons and constructing a plan.
- Activity 3 in which students tested and revised the plan.
- Activity 4 in which students matched and organized different objects.

Prepare a chart on the chalkboard which summarizes some of the steps that were suggested and followed in solving the problems of matching objects.

Ask students to supply the steps from their recall of the activities or from the word charts constructed in earlier activities.

Conclude the discussion with thought questions: Are other kinds of matching problems likely to occur in which the steps identified here won't be the best to use? What would be the best way to solve these problems? How would you match objects if you were visually or physically impaired?

Materials:

Results from Activities 2, 3, and 4.

Procedural Note:

While consensus should be reached for the "best" ways to match objects, consensus need not be reached on each step if good reasons are supplied. Thus, students can be helped to realize that there are some parts of problem solving we can all agree on, while in some parts there is room for differing opinions.

I

MEASURING

"WHICH IS MORE?"

MEASURING – "WHICH IS MORE?"

LEVEL I ________
(GRADE)

PROBLEM OVERVIEW

A child is often confronted with problems that have to do with making comparisons. Determining which distance is longer or shorter, which object is heavier or lighter, or which container is larger or smaller in capacity are only a few of the many instances that occur in presenting the problem. The activities in this unit identify situations in which the student cannot easily resolve comparisons unless measurements are made. Each situation poses a different kind of measuring problem that will expose the student to objects and events with distinctive properties, provide an opportunity for the student to develop the skill of measuring, and help the student develop science attitudes toward investigations.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Emphasis
1	Brainstorming "Which is More?"	▨						Classifying/Communicating Information A-2.24 Contributions, others I-C Objects, events, properties
2	Measuring Distance	▨	▨					Measuring/Manipulating Ideas A-1.31 Concepts, terms, techniques I-C-1.3 Object properties, amount of space
3	Measuring Temperature		▨	▨				Measuring/Manipulating Ideas A-2.21 Safety I-C-1.5 Object properties, surrounding conditions
4	Measuring Capacity			▨				Measuring/Manipulating Ideas A-2.22 Use of resources I-C-1.3 Object properties, amount of space
5	Measuring Surface				▨			Measuring, Using Numbers/Manipulating Ideas B-1.2 Resourcefulness, innovativeness I-C Objects, events, properties
6	Measuring Weight				▨	▨		Manipulating, Measuring/Communicating Information B-1.2 resourcefulness, innovativeness I-C-1 Object properties, material condition I-D-3.1 Uniform balance beam
7	Measuring Time					▨		Manipulating, Measuring/Communicating Information A-2.25 Truthful reporting I-C-2.2 Event, duration of time

SUGGESTED APPROACH

This unit is flexible in many aspects. The total amount of time to be devoted to the unit or to individual activities can be adjusted in accordance with the teacher's judgment of student interest and readiness. Comparison activities can be deleted or changed in sequence according to the results of the preliminary brainstorming activity.

Some of the activities in the unit may provide students with new experiences to reinforce learnings acquired earlier. Some activities may serve as an introductory experience for more formal instruction at a later time. Care must be taken to keep the emphasis of each activity at the appropriate level for the students at this point in their development.

The unit has a strong connection to mathematics, providing many opportunities to develop other specific skills and understandings listed in the mathematics syllabus.

MATERIALS

(per student, unless otherwise indicated)

Tongue depressors or ice cream sticks

Ruler (cm scale)

String, 1-2 meters

Paper tape, 1-2 meters

Thermometer (one per two students)

Containers of various sizes: cereal boxes, plastic cans, tubs, bottles, etc.

Medicine cup

Kitchen measuring cup

Paper cups, 8 oz.

Sponges, mops (available for class)

Pails, small, one for two to four students

Paper squares, approximately 5 cm square or 2¹/₈ inches square – 100

Wrapping paper, brown (one roll per class)

Geoboards (four per class)

Colored rubber bands (four sets per class)

Balance board and fulcrum, one for two to four students

Small washers, one bag per class

Large washers, one bag per class

Paper clips, one box per class

Plasticine, one package per class

Double-pan balance materials: support, pans (pie plates), balance arm, etc. – one for two to four students

Clock (wall type with sweep second hand) – one for class

Ice cubes, uniform size

Objects from home such as toys

MORE IDEAS

1. Make cutouts of hands, feet, or head profile. Use "very small" squares to determine the amount of surface.
2. Determine which is the shortest route from home to school.
3. Determine which is colder, warmer, or the same temperature: indoors-outdoors; one person's hand – another's hand; oral temperatures (done by nurse).
4. Determine which is heavier: one sheet of paper – a penny; one sugar cube and a glass of water – the sugar cube dissolved in the glass of water; a slice of bread – the slice of bread toasted; two slices of bread – 1 hard-boiled egg.
5. Determine volume change in popcorn when cooked. (1/4 liter uncooked equals what volume cooked? Compare brands.)
6. Determine which takes longer: cold water to freeze or hot water to freeze; a large diameter candle to burn a fixed length or a small diameter candle to burn the same length.
7. Determine "equals" in a student's own body dimensions: handspan, distance between ears, head size (circumference), arm length (nose to fingertips), foot size, knee height, step or pace, arm span, waist, length of nose, width of smile, etc. It is important for you to take into special consideration possible differences in a student's measurements due to a handicapping condition.

SYLLABUS EMPHASIS

Problem:

What different ways have you encountered the problem "Which is more?"

Concepts:

amount
capacity (space)
compare
distance
measure
quantity
surface (area)
temperature
time

Skills/Processes	**Inquiry:** Classifying • Students group questions raised through brainstorming. **Language Arts:** Communicating Information • Participating in brainstorming as a means of identifying questions to investigate.
Science Attitudes	A-2.24 Respecting the contributions of others to the solution of a problem. • Praising or complimenting suggestions made by others and listening attentively to these suggestions. • Accepting the ideas and efforts of a handicapped person in group problem solving.
Science Understandings	I-C Objects and events have distinctive properties. • The properties of objects and events are things to measure in trying to find "Which is more?"

Evaluation Strategy:

Group

The students are able to identify many questions related to "Which Is More?" and group them according to categories such as distance, weight, and temperature.

ACTIVITIES

1. BRAINSTORMING – "WHICH IS MORE?"

Conduct a discussion with the class about the problem question.

Explain to students that an example of the problem question could be "Which route to the school cafeteria is longer?" We might also recognize the same problem in trying to answer "Which is less?" or "Which are the same?" Through questioning, help students understand that in each case something is to be compared. We make comparisons by measuring some property of an object or event. Ask students to think of other questions which ask any of these three questions.

List questions on the chalkboard. Additional questions can be suggested by the teacher to help the brainstorming process.

Ask students how the questions might be grouped. Lead them through discussions to realize that each question is about a comparison of some property. Help students identify the property for each question and group the questions according to the property.

New lists of questions organized by groups can be written on chart paper for reference later in the unit.

SUPPLEMENTARY INFORMATION

Materials:

Chart paper

Procedural Note:

Questions raised that are related to values, such as which is better, prettier, or more honest, can be listed and left for further thought.

As the unit progresses, questions such as "How would you measure the prettiness of a flower or honesty of a person?" could be periodically raised for discussion in accordance with the interest of students and appropriateness to the situation.

The topic could be used as a lead into discussion on physical characteristics and how perceptions are affected.

SYLLABUS EMPHASIS **ACTIVITIES** **SUPPLEMENTARY INFORMATION**

Problem:

Which is more, your height or your armspan?

Concepts:

compare
distance around (circumference)
height
length (larger)
less
more
same as (equal)
width (smaller)

Skills/Processes	**Inquiry:** Measuring • Students use standard or nonstandard measuring materials to measure and compare distances. **Language Arts:** Manipulating Ideas • Summarizing statements can be made orally or in written form, such as "Tom's reach is more than his height."
Science Attitudes	A-1.31 Wanting to know concepts, terms, techniques, and conventions useful in understanding the natural world. • Trying to learn how to use materials for making measurements.
Science Understandings	I-C-1.3 The space occupied by an object is determined by properties of the objects. • Objects have size, which can be measured in quantities such as length, width, or height.

Evaluation Strategy:

Individual, Group

Students are able to manipulate measuring materials to measure distances and make comparisons to determine relative size.

2. MEASURING DISTANCES.

Ask students which distance they think is more, their height or their armspan (distance between fingertips of outstretched arms). The predictions can be tallied on chalkboard to compare with the results of the activity.

Let the class discuss methods they would use to determine which distance is more and what kinds of measuring devices could be used.

Provide students with the materials needed and allow them to make the measurements.

Results of measurements can be shared and recorded and compared with predictions.

Students should discuss problems they had to overcome while making the measurements and the methods they used which worked best. It may be appropriate to discuss how this task would be done by a student with a handicapping condition.

Materials:

Nonstandard measuring material such as string and paper tape

Rulers

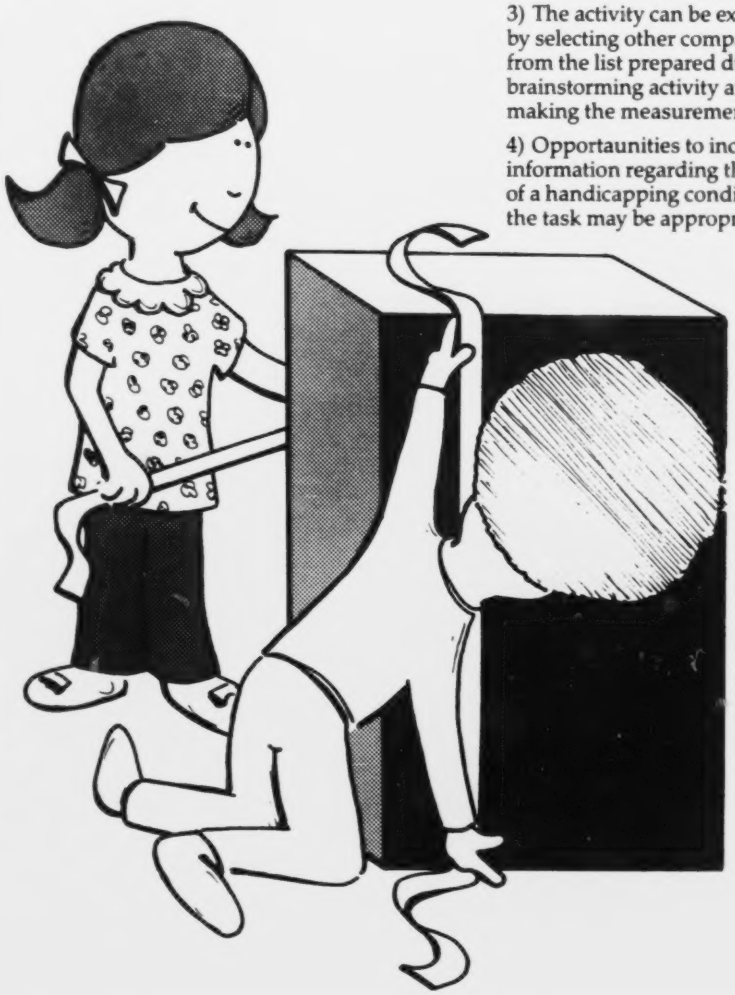
Procedural Note:

1) Measuring can be done in either standard units or nonstandard units depending on previous experiences or instruction.

2) Other measurement comparisons may occur to students to try such as: handspan to size of foot, waist to arm length, size of step to arm length, distance of broad jump to height or armspan.

3) The activity can be extended by selecting other comparisons from the list prepared during the brainstorming activity and by making the measurements.

4) Opportaunities to include information regarding the effect of a handicapping condition on the task may be appropriate.



SYLLABUS EMPHASIS

Problem:

Which location in the room is warmest (or coldest)?

Concepts:

change
cold
compare
hot (warm)
less
more
same as

Skills/Processes	**Inquiry:** Measuring • Students use thermometers to measure and compare temperatures. **Language Arts:** Manipulating Ideas • Summarizing statements can be made about relative temperatures or methods of measuring temperatures.
Science Attitudes	A-2.21 Valuing the use of investigative procedures which will limit the risk to one's self, others, or the living and nonliving environment. • Discussing and using proper procedures for measuring temperatures that are safe for the student and the thermometer.
Science Understandings	I-C-1.5 Some properties of an object are dependent on the conditions of the present surroundings in which the object exists. • A thermometer is an object whose properties change depending on temperature.

Evaluation Strategy:

Group

Students are able to manipulate thermometers to measure and make comparisons of temperatures.

ACTIVITIES

3. MEASURING TEMPERATURE.

Ask students which location in the classroom is warmest? Predictions can be tallied for various locations to compare with results of the activity.

Let the class discuss methods they would use to determine the temperatures and the devices they would need to measure the temperatures.

Provide students with the materials needed and allow them to make the measurement.

Results of temperature measurements can be shared and recorded and compared with predictions.

Students should discuss problems they had to overcome in measuring temperature and the methods they used which worked best.

SUPPLEMENTARY INFORMATION

Materials:

Thermometers

Procedural Note:

1) Students may require more instruction on the proper handling of thermometers, depending on their previous experience.

2) Other questions may arise relating to other temperature comparisons or in comparing temperatures over time. These questions can lead to extensions of the activity.

SYLLABUS EMPHASIS

Problem:

Which container holds more?

Concepts:

capacity
compare
full
less
more
same as
shape
volume

Skills/Processes	**Inquiry:** Measuring • Students use standard or nonstandard measuring devices to measure and compare capacities. **Language Arts:** Manipulating Ideas • Summarizing statements can be made about relative capacities of containers or about methods used to measure capacity.
Science Attitudes	A-2.22 Respecting the rights of others in using resources. • Leaving work areas neat for the next user.
Science Understandings	I-C-1.3 The space occupied by an object is determined by the properties of the object. • Containers of various shapes and sizes or capacities.

Evaluation Strategy:

Individual, Group

Students are able to manipulate measuring devices for capacity and to measure and compare capacities of containers.

ACTIVITIES

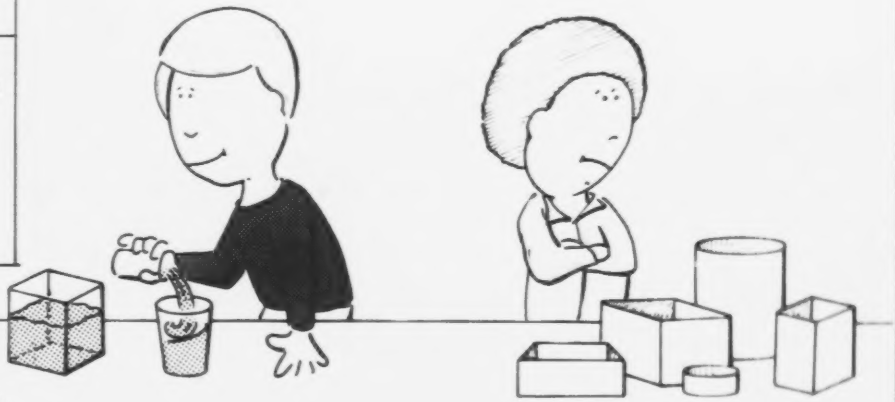
4. MEASURING CAPACITY.

Provide students with containers used for familiar materials but of different shapes. Ask the students to predict which container holds more (or most) and which holds less (or least) by arranging the empty containers in a row from most to least. They might also identify in the row any containers they think are the same. Conduct a discussion about how they made their predictions and how they might investigate to find out if their predictions are correct. Lead the questioning to help children realize that the capacities of the containers could be compared by using a substance such as water or sand and a measuring device.

Let the class discuss methods they plan to use and the measuring devices they would need to measure capacity.

Provide students with the additional materials they need and allow them to make the measurements.

Results of capacity measurements can be shared and recorded and compared with predictions. Students should discuss problems they had to overcome in measuring capacity and the methods they used which worked best.



SUPPLEMENTARY INFORMATION

Materials:

Containers of various sizes and shapes such as cereal boxes, jars, cans, plastic tubs

Measuring devices of various types such as kitchen measuring cups, medicine cups

Pails

Mops and sponges

Procedural Note:

1) It may be desirable to allow students to play with the containers and water (or dry substance) on their own before beginning the activity.

2) Other comparisons of capacity may occur to students. These can be discussed and pursued if appropriate. Others may be left as unsolved problems for a later time.

SYLLABUS EMPHASIS

Problem:

Which surface is bigger?

Concepts:

area
less
more
pattern
same as
shape
surface (area)

Skills/Processes	**Inquiry:** **Measuring** Using Numbers • Students measure and compare areas (surface) by counting the number of standard squares needed to cover the surface. **Language Arts:** Manipulating Ideas • Summarizing statements can be made about relative sizes of surfaces and about the methods used to measure the surface.
Science Attitudes	B-1.2 Valuing resourcefulness and innovativeness in the solution of practical problems. • Attempting to use materials such as squares in novel ways to solve the problem of measuring surfaces.
Science Understandings	I-C Objects and events have distinctive properties. • Objects have surfaces that have size.

Evaluation Strategy:

Group

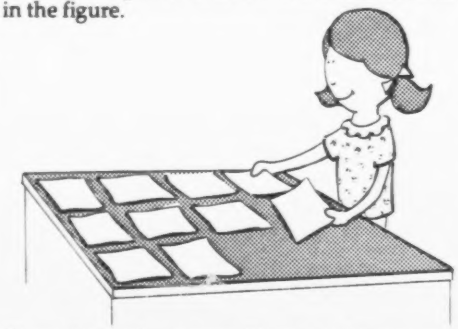
Students are able to manipulate squares to measure and compare the number needed to cover surfaces of objects.

ACTIVITIES

5. MEASURING SURFACES.

Show students many different flat surfaces such as tops of desks, tables, bulletin boards, and include round or irregular shapes as well as rectangular.

Conduct a discussion about how much surface is on each object and how the surfaces could be compared. Through questioning, help students become aware that each surface could be measured by covering it with squares. Then the number of squares could be counted as shown in the figure.



Show the students a small square of paper, and ask them to predict the number of squares needed to cover the top of their desk. Record predictions for later comparison.

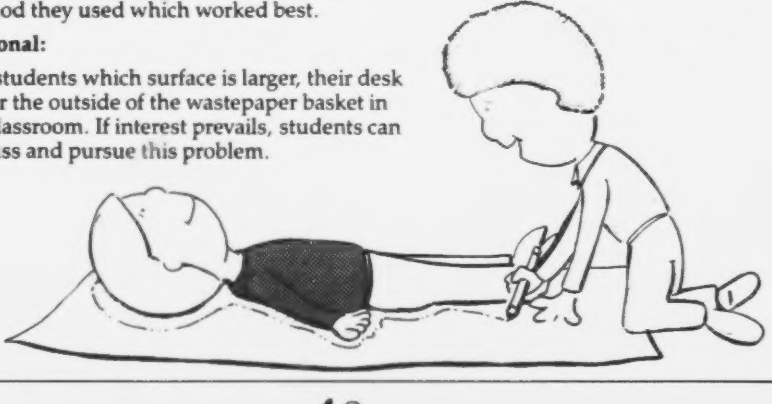
Provide students with the squares, and allow them to determine how many are needed to cover the desk tops. Compare the predictions with the actual measurements.

Ask the students to predict which of the objects shown earlier in the room has the largest surface and which has the smallest, or which objects have the same size surface. Let students discuss methods they will use to measure the surface when using the squares as measuring devices. Provide students with squares and allow them to measure the surfaces of the objects. Results of surface measurements can be shared, recorded, and compared with predictions.

Students should discuss problems they had to overcome in measuring surfaces and the method they used which worked best.

Optional:

Ask students which surface is larger, their desk top or the outside of the wastepaper basket in the classroom. If interest prevails, students can discuss and pursue this problem.



SUPPLEMENTARY INFORMATION

Materials:

Paper squares
Geoboards
Wrapping paper

Procedural Note:

1) If other methods are suggested by students to measure the surfaces, the methods can be discussed and used as alternatives, if feasible.

2) A learning center can be set up using the geoboard. Students can make shapes, determine the amount of surface, and replicate shapes that other students have made.

3) Opportunity will arise to discuss fractions as students encounter squares that overlap edges of objects.

4) Students may want to make "Me Maps" and determine the amount of surface of "Me." "Me Maps," made of brown wrapping paper, can be decorated and used as murals.

5) A type of "buddy system" may be implemented to assist students who may have fine or gross motor problems. Plastic or wooden chips could be used as alternatives.

SYLLABUS EMPHASIS

Problem:

Which object weighs more?

Concepts:

balance	light	same as
heavy	more	weight
less		

Skills/Processes	**Inquiry:** **Manipulating** Measuring • Use materials to construct a simple balance, and use the balance to determine relative weights of objects. **Language Arts:** Communicating Information • Students describe orally or as a class/group report the details and sequence of the test procedure used in the investigation.
Science Attitudes	B-1.2 Valuing resourcefulness and innovativeness in the solution of practical problems. • Attempting to use materials in novel ways to determine the relative weights of objects.
Science Understandings	I-C-1 The properties of an object are determined by its material and condition. I-D-3.1 Objects on a uniform balance beam may or may not be in balance depending on the location of the support. • Balance beams such as teeterboards or double-pan balances can be used to determine relative weights of objects.

Evaluation Strategy:
Group, Program

Students are able to identify procedures to determine relative weights, construct a simple balance to measure relative weights, and use the procedures and balance to measure the relative weights of objects.

ACTIVITIES

6. MEASURING WEIGHT.

Suggest to students that they play a game called a simulation. Explain that problem solvers often use simulations to help them solve real problems. A simulation is a form of make-believe that could really happen. Ask students to think of examples of simulations such as fire drills, practicing a speech before giving it to a group, or practicing an action like throwing a ball. Simulating a handicapping condition with a corresponding discussion could be used; for example, plugging ears to simulate hearing loss, rotating foot while writing, or covering one eye.

Simulation: You are an astronaut on the moon collecting rocks to be brought back to earth for study. You are to collect a quantity of rocks whose total weight must not exceed your weight. You are to bring back as many different kinds of rocks as you can find. Each rock sample should be as heavy as possible. No rock sample can be broken up into smaller pieces. (Each piece must be brought back as it was found.) You have discovered that the weighing scales you were to use were not put on the spaceship. Other materials were brought along that can be used in some creative way. Which rock samples will you bring back to earth?

Class Discussion:

Lead students in discussion about how they would determine how heavy the rocks are and how they could use the materials at hand to compare the rock weight to their weight.

As suggestions are made, they can be recorded. Several different suggestions should be identified. If new ideas occur during the testing of a suggested procedure, these can be recorded for later testing.

Provide students with the materials needed to test the suggested procedures. Allow the students to test procedures. Results of the simulations should be shared and discussed.

SUPPLEMENTARY INFORMATION

Materials:

Balance board and fulcrum
Materials to construct a double-pan balance
Samples of "rock" material, OR
Collections of toys

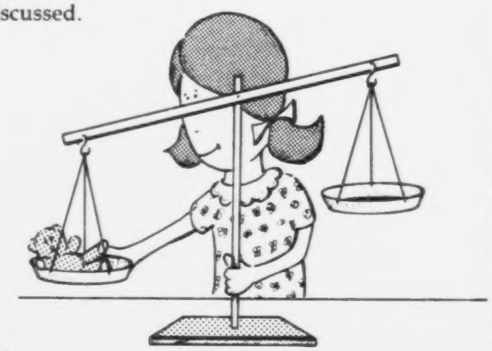
Procedural Note:

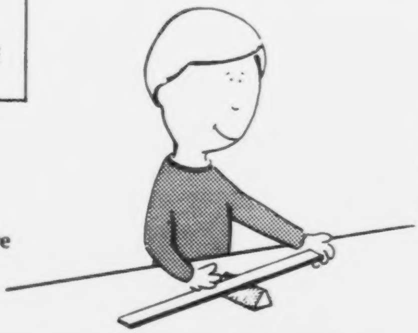
1) Other simulations could be substituted for the one presented here. The simulation should present a high-interest challenge to the students.

Example: You have won a contest to let you go to a toy store. You can have your choice of toys in the store. The only condition is that the total weight of the toys must not be greater than your weight. There is no balance scale for you to use, but your selections and you will be weighed before you leave the store. If the total weight of the toys is more than your weight, you will not be able to keep any of the toys.

2) The class can test each suggested procedure as a group, or teams can be formed. Each team can test a suggested procedure and report results to the class.

3) A "simulated student" in the form of a doll or representative object can be used to keep the weight totals at a smaller, more manageable level.





SYLLABUS EMPHASIS

Problem:

Which ice cube will melt first?

Concepts:

compare
less
more
same as
simultaneous
time
event

Skills/Processes	**Inquiry:** Manipulating Measuring • Students set up ice cubes in certain conditions to melt, and they measure and compare the melting times. **Language Arts:** Communicating Information • Students describe orally the details and sequence of the procedures they used in the melting race.
Science Attitudes	A-2.25 Valuing truthful reporting of methods and findings. • Accurately describing procedures used and honestly reporting the results obtained in the melting race.
Science Understandings	I-C-2.2 An event takes time to occur. • Ice cubes melt in a certain amount of time.

Evaluation Strategy:

Group, Program

Students are able to manipulate materials to set up melting conditions, measure melting times, and make comparisons of the results.

ACTIVITIES

7. MEASURING TIME.

Suggest to students that a race will be conducted called "The Great Ice Cube Melting Race." Explain that in the race individual ice cubes will be set up in conditions to be decided upon. The time will be measured for each ice cube to melt completely.

Through discussion, let students suggest many different sets of conditions in which to place the ice cubes. Methods of measuring the time should be discussed and decided upon.

Allow students to volunteer for race groups or "teams." Assign each team one of the sets of conditions to use for its cube.

Ask members of all groups to predict the amount of time they think will be required for each ice cube to melt. Record the predictions in a table for comparison with the race results.

Provide each group with the materials needed, and conduct the race.

Results of the time measurements for each group can be shared, recorded, and compared with predictions.

Students should discuss problems they had to overcome in measuring the melting time and the method they used which worked best.

SUPPLEMENTARY INFORMATION

Materials:

Uniform ice cubes
Various containers
Clocks with second hands
Sponges

Procedural Notes:

1) Different methods for measuring the time can be used if desired, or a single method can be used.

2) Students may want to repeat the race several times to get the "best" time. This could lead to developing the concept of "average."

3) Awards can be given if desired for various categories. Students may wish to determine the award categories.

I

FROM SEED TO PLANT

"WHAT CARE IS NEEDED FOR GROWING PLANTS?"

FROM SEED TO PLANT—"WHAT CARE IS NEEDED FOR GROWING PLANTS?" LEVEL I ____ (GRADE)

PROBLEM OVERVIEW

Some people seem to have "green thumbs" while others are not successful in raising even a simple marigold plant. What care is needed for growing plants successfully?

The unit explores this question to determine the skills, attitudes, and knowledge one needs to be able to successfully raise a plant from seed.

Children can become interested in growing plants for many reasons. Many will be naturally curious and just "want to know." A group project could be started in which the class decides it "wants to grow" plants for some specific purpose. The purpose could be to provide a gift for Mother's Day, Valentine's Day, shut-ins, or senior citizens. The purpose could also be to start plants for a personal garden.

Whichever purpose or purposes decided upon as the reason for growing plants, the prime outcomes of the unit should be healthy plants and students with an increased awareness of the proper care needed to raise healthy plants.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Emphasis
1	Experimenting With Conditions for Germination	▨	▨					Making Decisions/Communicating Information A-1.2 Respecting life I-A-1 Plant, properties, needs; I-A-1.3 Seasonal changes
2	Observing Seed Parts	▨						Observing/Developing Vocabulary A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions
3	Experimenting With Planting Seed Parts	▨	▨					Inferring/Communicating Information A-2.14 Careful, systematic investigation I-A-1.1 Plant parts, functions
4	Experimenting With Growing Plants		▨	▨				Making Decisions/Communicating Information A-2.21 Safety; A-2.24 Contributions, others I-A-1 Plant, properties, needs
5	A Planting Project		▨	▨	▨	▨	▨	Decision Making/Communicating Information A-1.21 Individual life, precious I-A-1 Plant, properties, needs; I-A-1.1 Plant functions
6	Comparing Plant Parts		▨	▨				Observing/Questioning A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions
7	Observing Plant Roots			▨	▨			Inferring/Communicating Information A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions
8	Experimenting With Leaves			▨	▨			Inferring/Communicating Information A-2.14 Careful, systematic investigation I-A-1.1 Plant parts, functions
9	Experimenting With Stems			▨				Inferring/Communicating Information A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions
10	Summarizing Plant Care				▨			Generalizing/Communicating Information A-1.21 Individual life, precious A-2.24 Contributions, others I-A-1 Plant, properties, needs
11	Summarizing Plant Parts Functions				▨			Generalizing/Manipulating Ideas A-1.11 Complexity, diversity, intricacy I-A-1.1 Plant parts, functions; I-A-1.11, 1.12, 1.13

SUGGESTED APPROACH

This unit is intended to be conducted at an introductory level for most of the skills, attitudes, and understandings, except where indicated otherwise in the activities.

The students may have had some minimal experience in growing plants prior to this unit, but probably this will be the first time in their lives they will personally plant a seed and watch it grow. Therefore, it is important to maintain teaching perspective as the students are confronted with the problem of raising plants. Allow the joy, excitement, and natural learning opportunities to occur without overwhelming the students with having to master the specific learning outcomes.

Opportunities to grow plants and to provide care for other living things need to occur in the future so that the skills, attitudes, and knowledge developed in this unit will be reinforced.

MATERIALS

Seeds:
Marigold, two packets
Peas, one packet
Lima beans, one packet
Flower or vegetables, other, one packet

Potting soil, 3/4 cu.ft. (approx.20 liters) (If class garden is planted in Activity 5, approximately three cu.ft. or 100 liters additional soil will be needed.)

Sand, 1/2 gallon (approximately two liters)

Plastic bags (quart size, freezer type) – 30

Paper bags (lunch size) – 24

Sponges, small – 16

Sorting trays (paper plates) – 30

Planting pots (peat material) or discarded 1/2 pt. (1/4 liter) milk containers – 60

Milk cartons – 1/2 gallon (2 liter) discarded – five or six

Trays (cafeteria) or shallow boxes – two or three

Plastic sheets (liners) – two

Vegetables, fresh

White potato – five or six
Sweet potato (optional) – five or six
Winter onion (optional) – five or six
Celery – one bunch

Leafy house plant branches

Woody plant branches, including evergreen

Plastic cups (clear) 6-8 oz.(approximately 1/4 liter) – 12

Food coloring – red or blue – one vial

Toothpicks – one box

Planter sticks (tongue depressors or discarded ice cream sticks) -60

Balsa wood sticks or dowels – five or six

MORE IDEAS

1. Take a field trip to collect seeds and seed pods. Plant these seeds and watch them grow.
2. Make displays of animals which eat seeds and the seeds that they eat.
3. Write or tape record a song about seeds and plants.
4. Write or tape record a story about how it feels to be a sprouting seed.
5. Read stories about farming or growing gardens.
6. Take your plant home at the *end* of the school year, and grow it in your garden or yard.
7. Find out if all plants grow from seeds.
8. Take a field trip to a greenhouse, farm, or tree nursery.
9. Draw pictures of your plant as it grows.
10. Discuss the importance of plants. What kinds of products do we get from plants?
11. Plant seeds on a wet sponge, cotton, paper towels, or blotters.
12. Play "What am I?" Pin the name of a plant on the back of each student. The student tries to discover "Which plant am I?" by asking other students questions that can be answered "yes" or "no." When the student identifies the plant, the tag is pinned on the front. Additional: This game can be used with other lessons as well as using trees, mammals, or birds.
13. Have a vegetable party with raw vegetables in conjunction with the cafeteria food service. Ask "What part are you eating – seed, root, stem, leaves?"
14. Make soup from the vegetables.
15. Use the language experience method to write a cinquain about seeds.

SYLLABUS EMPHASIS

Problem:

How can we cause a plant to grow?

Concepts:

alternative
conditions
germinate
grow
method
needs
respect
seed

Skills/Processes	**Inquiry:** Making Decisions • Identifying alternative ways to cause a plant to grow. **Language Arts:** Communicating Information • Participating in brainstorming as a prelude to an investigation.
Science Attitudes	A-1.2 Respecting life in the natural world. • Appreciating the fact that a seed holds the possibility of new plant life and that caring for it properly can give rise to a growing plant.
Science Understandings	I-A-1 Each plant has properties that enable the plant to meet its needs. I-A-1.3 The parts of some plants undergo seasonal changes that enable the plant to grow. • Seeds are able to use conditions of their surroundings to germinate and grow.

ACTIVITIES

1. EXPERIMENTING WITH CONDITIONS FOR GERMINATION.

Conduct a plant-starting contest: Give each group of four or five students a set of the materials listed at the right. Present the following challenge:

Using just these materials, which group can produce the single tallest plant in seven days? Rules:

1) Each group can have no more than six set-ups or entries.

2) Each entry must be different, must include at least three seeds, and must use only the materials supplied.

3) Entries may be kept anywhere in the room approved by the teacher. They may be moved during the contest, but *only water* may be added.

4) When dividing the class into groups it is important to consider the individual needs of students with handicapping conditions.

Suggestions:

1) Try many different ways so if one doesn't win for your group, another might.

2) Plan what your group will try before starting.

3) Amounts of water may be important, so your group should record how much is used for each entry.

Class Discussion:

Conduct a discussion after the entries are in place, and have groups report what they are trying. Entries cannot be changed at this point. How did each group "think up" its entry? Did one or two people tell the rest, or did each person come up with an idea? Who thought up many ideas in each group? How did those persons think of their ideas?

Introduce the term "germinate" for the process of beginning a plant from a seed.

Class Discussion:

After about seven days, or when significant growth has occurred, conduct a discussion. The entries should be placed in order by plant height to compare the conditions under which seeds seem to grow best.

What conditions do the winning entries have in common? List these on the chalkboard or on chart paper.

Which of the following are needed for the seed to start growing: air, water, soil, light, heat,

SUPPLEMENTARY INFORMATION

Materials:

For each student group:

10 marigold seeds per four students

10 pea seeds per four students

2 plastic bags per four students

1 cup of sand per four students

1 cup of potting soil per four students

2 paper bags per four students

2 small sponges per four students

2 planting cups per four students

Safety Note:

Caution students not to put seeds in their mouth, ears, or nose. Seeds should not be eaten.

Procedural Notes:

1) If you suspect that the students will have difficulty coming up with reasonable ways of starting the seeds, you might wish to have a discussion about some possibilities; e.g.,

- seeds placed under a wet sponge in a plastic bag, with bag open or closed;
- seed on top of the wet sponge instead;
- paper bag instead of plastic bag;
- seeds in sand, wet or dry, or on top of sand, near radiator or near window;
- seeds buried deep in soil, shallow in soil, without water, with water, covered with bag, not covered with bag, etc.

The objective is variation in method. No attempt should be made to have students vary only one condition at a time. Most primary-age children are too young to understand the logic required to design controlled experiments on their own.

2) Try to have several winners by allowing ties or by having

Evaluation Strategy:

Group, Program

Students are able to devise and test several sets of conditions for germinating seeds.

darkness? For each of these items, did any seeds start without that item? Are these things available to seeds out-of-doors? Indoors?

Were the same items needed for both types of seeds? Probe for details concerning such things as the specific amount of watering and depth of planting needed for success.

If a person wanted to grow a marigold or pea plant, how would he/she start the seed growing?

What did we learn from the entries which did not work? How much would we have learned if all groups had tried the same method?

Are seeds alive before they "germinate?" What do you think is inside a seed? Can things which are not alive turn into living plants? What should we do with our small growing plants?

Wrap-Up:

Students should attempt to transplant seedlings which are not in soil into cups of soil which can be kept in a shallow tray of water. See Appendix.

Using what they have learned about starting the growth of seeds, students might want to grow plants for a project. See Activities.

various categories. The objective is to narrow down the necessary conditions for good seed germination and early growth. Seed depth and amount of water are most often the questionable factors.

SYLLABUS EMPHASIS

Problem:

What is inside a seed?

Concepts:

appreciate
cotyledon
embryo (tiny plant)
intricacy
observe
seed coat (skin)
structures

Skills/Processes	**Inquiry:** Observing • When studying natural objects, it is sometimes helpful to examine the details of their internal structure directly. **Language Arts:** Developing Vocabulary • Listing words that describe the properties of seeds.
Science Attitudes	A-1.11 Appreciating the natural world, its complexity and diversity, its lawfulness and consistency, and its intricate detail and vastness. • Marveling at the intricate detail observed inside a seed. • Acknowledging the differences, similarities and interdependencies in nature.
Science Understandings	I-A-1.1 The parts of plants have functions that help the plant to live and thrive. • Seeds have distinct parts which may serve different functions.

Evaluation Strategy:

Group, Program

Students are able to open a soaked bean seed and describe its properties.

ACTIVITIES

2. OBSERVING SEED PARTS.

Provide students with the materials listed at the right.

Ask students to observe the properties of the two bean seeds. List their observations on chalkboard or chart paper and discuss the comparisons. Note that the soaked seeds have swollen in size and the skin comes off easily. After students have opened the soaked seeds, list and discuss their observations of the inside of the seeds, including the tiny plant.

Students can draw and label a picture of an open seed or color and label a predrawn picture, if desired.

Class Discussion:

Help students identify and answer questions such as:

How are the soaked seeds different from the dry seeds?

How do these seeds compare to the seeds planted in Activity 1?

What did you expect to see inside the seed before you opened it?

Which part of the seed do you think will grow into a plant?

What do you think will happen to the other parts of the seed?

Which parts do you think are needed for the seed to grow?

SUPPLEMENTARY INFORMATION

Materials:

For each student:
- 1 soaked lima bean seed
- 1 unsoaked lima bean seed
- 1 sorting tray (paper plate)

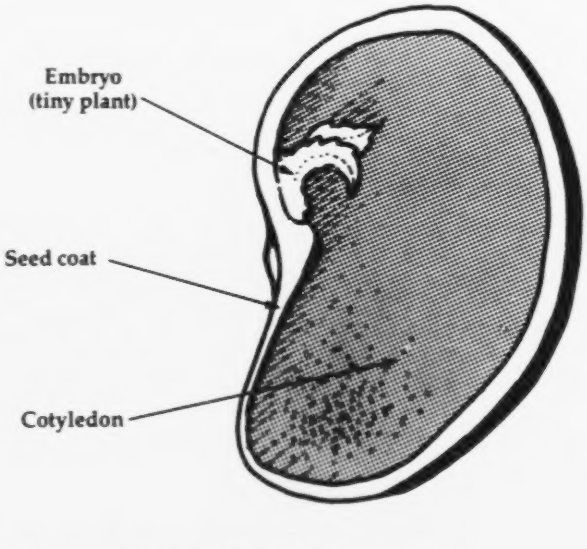
Preparation:

Soak seeds in water for 24 hours prior to this activity. Caution: after 30 hours of soaking, the seeds may begin to rot.

Procedural Note:

This activity can be conducted while waiting for Activity 1 to come to completion.

This activity is only an introduction to the idea that seeds have distinct parts which meet needs for development into a new plant. The idea will be developed further in Activity 3. Parts of the seed can be labeled, but do not elaborate on functions at this time. Three-dimensional models of seeds should be used to visually reinforce the various parts of the seed.



STRUCTURE OF A BEAN SEED

SYLLABUS EMPHASIS **ACTIVITIES** **SUPPLEMENTARY INFORMATION**

Problem:

Which parts of a seed are needed for it to grow into a plant?

Concepts:

conditions
embryo (tiny plant)
experiment
germination
infer
seed food (cotyledon)
valuing

Skills/Processes	**Inquiry:** Inferring • Stating the probable cause of differences in the germination of seeds from observable differences in seed condition. **Language Arts:** Communicating Information • The details, sequences, and outcomes of the activity can be written as a class report.
Science Attitudes	A-2.14 Valuing careful, systematic investigation as useful in resolving issues. • Valuing an experiment which has been set up carefully, because the results are more easily interpreted.
Science Understandings	I-A-1.1 The parts of plants have functions that help the plant to live and thrive. • At least the tiny plant (embryo) and seed food (cotyledon) are needed for consistently healthy germination of the seed.

Evaluation Strategy:

Individual

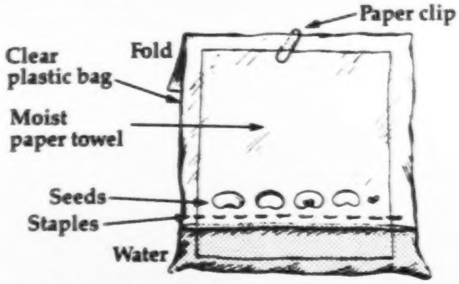
Students are able to express in their own words the understandings above.

3. EXPERIMENTING WITH PLANTING SEED PARTS.

Ask students which parts of a soaked bean seed they can remove to see if they are needed for growth.

Through discussion, lead the students to try those shown in the figure below.

Provide each group of four or five students the materials listed at the right. Let the students assemble the germination bags as shown.



From left to right: a complete bean, bean with seed coat removed, bean with one cotyledon removed, one cotyledon only, the embryo only.

Fasten the completed germination bags to a wall, bulletin board, or chalkboard for easy observation.

By having several groups try the experiment, variation from one seed to another is overcome.

After several days, conduct a class discussion.

Class Discussion:

Were all seeds in your germination bag treated the same except for the parts present? Was the comparison fair?

How neat was your setup? How carefully did you assemble the germination bag? When the bag was set up neatly, was it easier to understand the results?

In which experiments did each part at least start growing?

Chart the results on the chalkboard as shown at the right.

In each group, which seed part grew best? For each group, circle the "x" in the chart for the best growing seed.

Which part or parts grow? Which parts are needed for growing? How do you know this? Can you be sure? Did you see them being used or did you figure it out? If you figured out what is happening rather than actually observing it, we say that you "infer" that it happened.

Which parts can be removed and at least some seeds will still start growing? Do all whole seeds grow?

Materials:

For each group of students:
1 plastic bag
1 paper towel
5 soaked bean seeds
Paper clip

For the class:
Stapler
Water

Safety Note:

Caution students not to eat the beans. Discuss reasons why this is important.

Preparation Notes:

The students' stage of development will determine whether or not advance preparation of the germination bags is necessary.

Students may be able to add the seed parts and then water and complete the task.

Procedural Notes:

The terms "cotyledon" and "embryo" can be avoided, if desired, by using "seed food" and "seed plant" instead.

The major understanding to be derived from the activity is that whole seeds grow best. From this it might be inferred that the various parts of the seed serve the needs of the seed during germination.

	Student Groups				
	A	B	C	D	E
1) whole bean	x	x		x	x
2) bean without seed coat					
3) bean with 1 cotyledon only					
4) cotyledon only					
5) embryo only					

Problem:

What does a plant need to grow well?

Concepts:

alternative	method (technique)
care	needs
contributions	respect

Skills/Processes	**Inquiry:** Making Decisions • Identifying alternative methods for caring for plants. **Language Arts:** Communicating Information • Participating in brainstorming as a prelude to an investigation.
Science Attitudes	A-2.21 Valuing the use of investigative procedures that limit the risk to one's self, others, or the living and nonliving environment. • Taking care not to injure plants as part of an investigation without justifiable reason. A-2.24 Respecting the contributions of others to the solution of a problem. • Listening to suggestions of others can be helpful in thinking of alternatives.
Science Understandings	I-A-1 Each plant has properties that enable the plant to meet its needs. • A plant thrives under certain conditions of moisture, temperature, light, available space, and soil. Under other conditions, the plant grows poorly or dies.

Evaluation Strategy:

Group

Students are able to generate suggestions for plant care.

4. EXPERIMENTING WITH GROWING PLANTS.

After all of the seeds started earlier have germinated, show the class the planters that have been prepared and describe how the seeds were planted about a week earlier. Conduct a discussion about what conditions a plant needs to grow well. Invite many and varied suggestions. Probe suggestions for details. For example, if watering is suggested, ask the student "How much, and how often?" Encourage ideas by asking questions.

Class Discussion:

How should these plants be cared for so they will grow well?

Where should plants be kept in the room?

Should all three plants be kept in the same container?

As suggestions are made and discussed, offer to give the students plants to care for in the way each suggested. Keep a record on chart paper of students receiving plants and the type of care they plan to give to the plants. The records will be needed later when results are compared.

During, or at the end of, the plant care discussion, ask students questions such as:

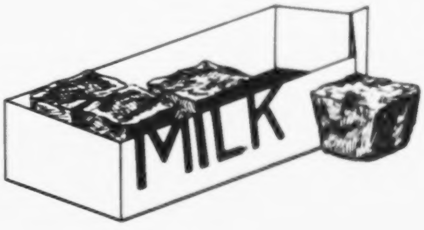
Where did you get the idea you suggested?

Does listening to the suggestions of others help you with ideas?

What kind of suggestions made you think more?

Hand out the plants at the end of the discussion, and let the students start to apply their suggestions.

Monitor regularly the results students obtain and conduct informal discussions, but leave the formal concluding discussion for Activity 10.



Materials:

100 marigold seeds
30 planting cups
5 or 6 half-gallon milk cartons
Potting soil

Preparation Notes:

One week before this session plant three marigold seeds in each of 30 planting cups filled with potting soil. Plant seeds with just a sprinkle of soil on them. Place the cups in two-liter (half gallon) milk cartons, which serve as a tray as shown in the figure below. Maintain 1 cm of water in the tray. Too much water will cause mold; too little will prevent germination.

Procedural Notes:

1) The techniques for caring for plants discovered in this activity will be used to increase the chances for success in the planting project, Activity 5.

2) There may be more than one way to care successfully for any plant; so, provided that there is some supporting evidence, do not insist that all students agree on the best way to care for plants.

3) Note that in this procedure students who generate alternative ways of caring for a plant get a plant to care for. This provides an incentive for generating alternatives.

If some students are convinced that their plant is not doing well and want to switch to some other method of caring, allow them to do so, but ask them to remember what they did that did not work for later class discussion. Within a week or two it should be possible to conduct a class discussion on the effects of different methods of caring for growing plants. Do Activity 10 at that time.

SYLLABUS EMPHASIS | **ACTIVITIES** | **SUPPLEMENTARY INFORMATION**

Problem:

How can a healthy plant be grown?

Concepts:

appreciate	plan
conditions	proper care
methods	respect

Skills/Processes	**Inquiry:** Making Decisions • Using all available sources of information in solving a problem that requires a decision on "what should be done" helps in choosing an effective course of action. **Language Arts:** Communicating Information • Participating in planning and brainstorming as a prelude to conducting a project.
Science Attitudes	A-1.21 Respecting each individual life as precious to the individual and others. • Appreciating that giving proper care to growing plants can lead to a product which brings satisfaction to oneself and others.
Science Understandings	I-A-1 Each plant has properties that enable the plant to meet its needs. I-A-1.1 The parts of plants have functions which help the plant to live and thrive. • Plant parts function throughout the lifetime of the plant, as they make use of water, sunlight, and surroundings for the growth and development of the plant.

Evaluation Strategy:

Group

Students are able to plan a project involving growing a plant, to conduct the project, and to produce a healthy plant.

5. A PLANTING PROJECT.

Plan a planting project with the students such as growing a plant to give someone as a gift (on Valentine's Day or Mothers Day or to senior citizens or shut-ins) or growing a small garden of plants.

Class Discussion:

Review what has been learned about planting seeds from earlier activities. Students should discuss how to provide the best conditions for starting the plants from seeds.

Figure 1 shows an arrangement which can be used for individual potted plants.

FIGURE 1

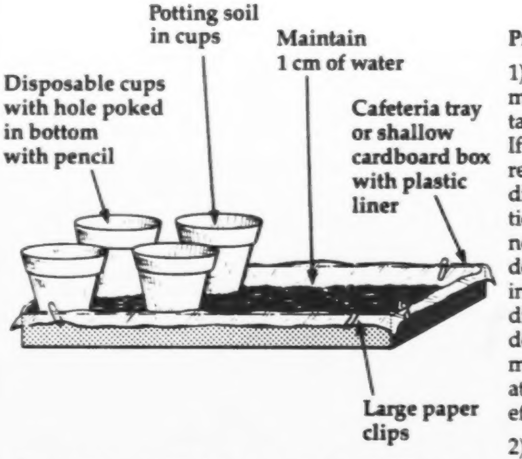
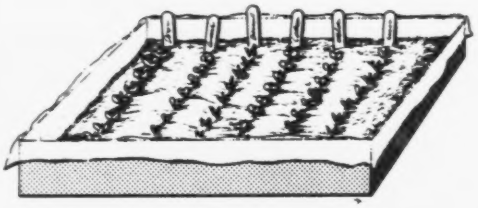

Potting soil in cups
Maintain 1 cm of water
Disposable cups with hole poked in bottom with pencil
Cafeteria tray or shallow cardboard box with plastic liner
Large paper clips

Figure 2 shows an arrangement for a classroom garden.

How many seeds should be planted in each cup? Which seeds should be planted? How much water should be added? Where should the plants be located for the best light?

FIGURE 2



How many rows should be planted in a garden? Should large seeds be planted as close together as small seeds? How can we keep track of which seeds are planted?

Materials:

For each student:
- 1 planting cup
- 5 marigold or other seeds
- 1 cup potting soil

For the class:
- Trays or shallow cardboard boxes
- Plastic sheet for liner

For the garden:
- 1 or more large cardboard boxes (20 cm x 100 cm x 100 cm)
- Plastic sheet for liner
- Potting soil (about 3 cubic feet or 100 liters)
- Variety of seeds (vegetables or flowers)

Procedural Notes:

1) For either setup, the class might decide to have individuals take turns caring for the garden. If so, help students schedule responsibilities. Periodic discussions of how responsibilities are being met might be necessary. Encourage the class to decide how to see to it that individuals do their part. Such discussions can play a role in developing group decision-making skills and desirable attitudes toward sharing of effort.

2) As individual problems with the project arise, they should be referred to the class for discussion and solving. This will provide students with the opportunity to practice problem solving. Using evidence from previous activities, books, or other authorities should be encouraged. The project should be carried through to a successful product. See Appendix for further tips about plant care.

SYLLABUS EMPHASIS

Problem:

Which parts are similar among green plants?

Concepts:

appreciation
consistency
leaves
parts
roots
specimen
similarities
stems
structures

Skills/Processes	**Inquiry:** Observing • Examining a collection of objects for parts which are similar. **Language Arts:** Questioning • Using what is already known about plants to raise questions that will lead to further study.
Science Attitudes	A-1.1 Appreciating the natural world. • Appreciating the consistency and simplicity of the overall structure of almost all green plants.
Science Understandings	I-A-1.1 The parts of plants have functions that help the plant to live and thrive. • Almost all green plants have similar structures: leaves, stems, and roots.

Evaluation Strategy:

Individual

Students are able to identify plant parts including roots, stems, and leaves from several common green plants.

ACTIVITIES

6. COMPARING PLANT PARTS.

Gather as many different plants as you can for classroom study. This can be done by having students bring in plants, going on a collection walk outside, supplying the plants yourself, getting throwaways from a florist or garden shop, or doing a combination of these. The plants should include some grasses, broad-leafed plants (such as dandelion), and some small woody-stemmed plants. (Including some vegetables, climbing plants, weeds, evergreens, and potted plants adds to the variety.) At least the roots, stems, and leaves of the plant should be available for study. Buds, flowers, and seeds may or may not be included. Caution students not to harm plants which others may value. Display the plants on a large table or shelves or on the floor for class study and discussion. Soil may have to be rinsed off the roots to make them visible. Keeping uprooted live plants in jars of water helps keep them alive, although plants do not have to be alive for the activity.

Class Discussion:

Which parts do all specimens seem to have in common? What parts do only a few specimens have?

For each of the major plant parts, roots, stems, and leaves, ask in turn: Are there any plants which do not have the part (e.g., roots)? If a particular specimen does not have the part, ask if it did have the part at one time (or will have it). Are all leaves green? Do all roots grow in soil? Are all leaves flat? Are all stems stiff? Are all roots bushy? Do all stems branch? Do leaves ever have roots (ivy)? Do the roots or stems of different types of plants branch in similar ways?

Ask the open-ended question "Why do most common plants have roots, stems, and leaves?" Let students speculate on this question without reaching any conclusions at this point. This question serves as a lead-in to the next four activities.

Students can draw pictures and label parts of their favorite plant from among those collected.

If there are any plants of value in the collection which can be salvaged, let students do so by returning them to where they were taken from. Undried specimens may be pressed and displayed. Dried ones can become part of decorative displays.

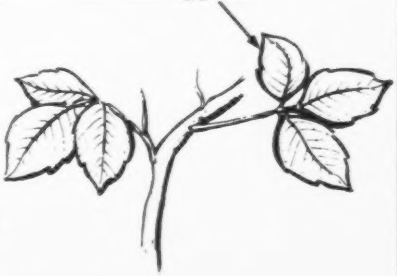
SUPPLEMENTARY INFORMATION

Materials:

A collection of many and varied whole plants including leaves, stems, and roots of each plant.

Safety Note:

Caution students not to eat any plant parts. Instruct students on the appearance of poison ivy and poison oak if these may be encountered while collecting plants.


Shiny red or green leaves on short ground or climbing plant

Procedural Note:

1) This collection also provides an opportunity to have students notice differences and to attempt to sort the collection based on chosen properties. Playing a variation of "20 Questions" or having a student describe a plant and having others guess which one it is are some activities which can be done at this time.

2) A nature walk could be substituted for the collection but may have the limitation that students will not have a chance to see a variety of roots clearly and may not afford as much time to examine specimens without distraction. It is important that nature walks are accessible to students with handicapping conditions and that assistance is provided in completing this activity.

SYLLABUS EMPHASIS | **ACTIVITIES** | **SUPPLEMENTARY INFORMATION**

Problem:

How do plant roots serve the plant?

Concepts:

appreciate
function
infer
root
serve
take in
water

Skills/Processes	**Inquiry:** Inferring • Stating that the probable cause of a loss of water is that it was taken in by the roots. **Language Arts:** Communicating Information • Students can describe the main ideas, details, and sequence of the activity in a class report.
Science Attitudes	A-1.1 Appreciating the natural world. • Appreciating the way plant roots serve a function for the whole plant.
Science Understandings	I-A-1.11 Roots help plants take in water. • Roots serve the function of taking in water used for growth by the plant.

Evaluation Strategy:

Group

Students are able to describe observations of the growth of a potato and identify the roots, stem, and leaves.

7. OBSERVING PLANT ROOTS.

Suspend a white potato in a clear plastic container of water. (A sweet potato or an onion may be substituted for the white potato or done in addition, as shown in the figure below.)

Toothpicks are pushed into the potato around the middle. They will rest on the top rim of the container and will hold half the potato out of the water. Observe daily and add water as needed. When the potato has grown roots, the potato can be transplanted to soil (garden). Cover half the original potato with soil. Discuss observations of the parts of the potato, and identify roots, stems, and leaves.

Class Discussion:

Where does the water seem to go?

Why is it necessary to keep adding water?

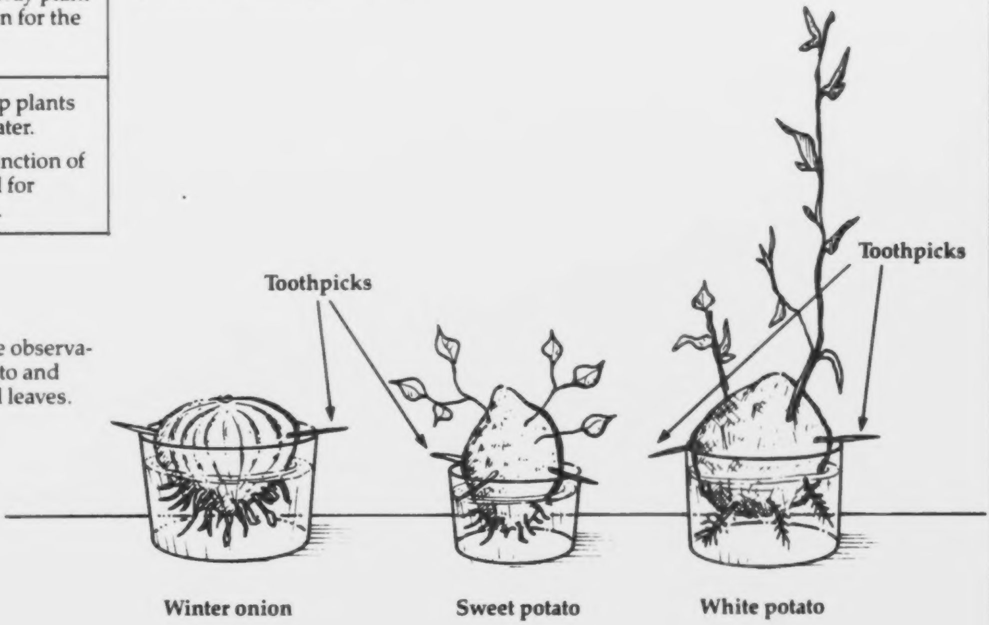
What do you think the roots are doing?

Introduce the idea that we have not actually observed the water going into the roots but that we are "inferring" it from the change in water level. Recall other examples of inferring from observations in earlier activities.

Using the plant collection from Activity 6, have students examine and compare roots of various plants. If hand lenses are available, have them inspect undamaged root specimens and draw a picture of a small piece of root.

Materials:

White potato
Sweet potato
Winter onion
Toothpicks
Clear plastic container
Water



SYLLABUS EMPHASIS

Problem:

How do plant leaves serve the plant?

Concepts:

appreciate
function
infer
leaves
light
serve
take in

Skills/Processes	**Inquiry:** Inferring • Stating that different plant growth under different lighting conditions was probably caused by leaves affecting plant growth. **Language Arts:** Communicating Information • Students can describe the main ideas, details, and sequence of the experiment in a written class report.
Science Attitudes	A-2.14 Valuing careful, systematic investigation as useful in resolving issues. • Valuing carefully designed investigations because the results are easier to understand.
Science Understandings	I-A-1.1 The parts of plants have functions that help the plant to live and thrive. • Green plants grown with leaves in light tend to have a greener, healthier appearance. The growth of stems seems to bend the leaves toward light.

Evaluation Strategy:

Group

Students are able to identify differences in plant growth and appearance and infer the probable causes.

ACTIVITIES

8. EXPERIMENTING WITH LEAVES.

Conduct a discussion with the students about the problem question. Lead the students to question how light and leaves might be related. If the students are capable, have them design an experiment similar to the one that follows.

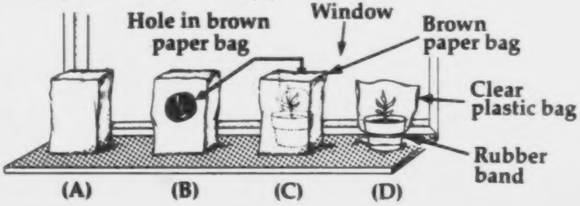
Use plants from Activity 7 which are similar in size and health. It may be desirable to have several similar setups in order to average out variations among the plants.

As the experiment is set up, explain to the students that the purpose is to give the leaves of each plant a different amount of light. All other conditions for the plants will be the same.

1) Place a clear plastic bag over each of the four plants after placing them on a shelf near a window.

2) Over the first plant, place a second brown paper bag.(A)

3) Over the second plant, place a second brown paper bag with a two-inch hole cut in it facing away from the window.(B)



4) Over the third plant, place a second brown paper bag with a two-inch hole cut in it facing toward the window.(C)

5) Leave the fourth plant with only the plastic bag over it.(D)

In all other aspects, treat the three plants the same over the next few days. They should need little, if any, water because of the plastic bags, which reduce evaporation. Do not turn the bags or plants during the experiment. The paper bags can be removed briefly for a daily check on changes. When the plants show clear differences in growth, conduct a class discussion.

Class Discussion:

How are the plants different? Which are greenest? tallest? healthiest? straightest? Why did they grow differently? Could the differences be explained by the amount of air? water? soil?

If we had left the plastic bags off all the plants, what might have explained the differences? (air or moisture)

If we had started with plants which were quite different in size or health, could we be sure of what caused the differences? Is it helpful to set up an experiment carefully? Is light helpful to plants? How does it affect health and growth? Which part of the plant seems to take in the light?

SUPPLEMENTARY INFORMATION

Materials:

4 plants similar in size and health from Activity 4
4 clear plastic bags and rubber bands
4 brown paper bags

Procedural Notes:

1) Students at the primary level typically do not understand the logic of controlled experiments, although the concept of "fair test" or "fair comparison" is understood, and with guidance they can set up and interpret simple experiments.

2) Although plants grown in darkness for a while grow taller, they tend to be paler in color and spindly in appearance.

SYLLABUS EMPHASIS

Problem:

How do plant stems serve the plant?

Concepts:

appreciate
carry
function
infer
serve
stem
support

Skills/Processes	**Inquiry:** Inferring • Stating that stems seem to serve the plant by supporting and positioning leaves and carrying water from the roots. **Language Arts:** Communicating Information • Students can describe the main ideas, details, and sequence of the activity by writing a class report.
Science Attitudes	A-1.1 Appreciating the natural world. • Appreciating the way plant stems serve a function of the whole plant.
Science Understandings	I-A-1.1 The parts of plants have functions that help the plant live and thrive. • Stems of plants serve the functions of carrying water to plant leaves and supporting and positioning leaves in light.

Evaluation Strategy:

Group

Students are able to identify changes in the appearance of plant stems that are carrying colored water and to infer the probable cause.

ACTIVITIES

9. EXPERIMENTING WITH STEMS.

Place the fresh-cut stems of some growing plants (or their branches) in a jar of water dyed with food coloring. Leave the leaves on some stems and take them off others. Include celery, a leafy house plant, and a woody plant such as a maple and/or an evergreen branch. Also put a piece of wood or two, such as a wood dowel, in the jar. After several hours or a day, carefully split the stalks with a heavy knife.

Have students observe how far up the stalk the colored water has traveled. Can it be seen in the leaves of some plants? Using a hand lens, students should examine and describe the appearance of the stalks and the piece of wood.

Class Discussion:

How do the stems seem to serve the plant? Can we be sure that they carry water in the same way to a growing plant? Is it safe to "infer" that they do? Can you think of an experiment to test this inference?

How does water get into the plant? How does it get to the leaves?

Where do wooden boards come from?

Can you tell what position a piece of wood was in when it was in the stem of a tree? How does its inside compare in appearance to that of a celery stem? Can water move up through a board?

What else do stems do? (Provide support for and control the position of leaves for taking in light.)

SUPPLEMENTARY INFORMATION

Materials:

Plant stems, with and without leaves, from celery, leafy houseplants, woody plants, evergreen branches
Balsa wood sticks or dowels
Jars of water with red or blue food coloring
Hand lenses

Safety:

Use caution when splitting woody stalks or sticks with a knife.

Procedural Note:

Allow students to test other plant materials and branches in this way. White carnations can be made to take on the color of the liquid they are in. What happens if a plant with roots is placed in the colored water?

SYLLABUS EMPHASIS

Problem:

What is the proper method to care for a plant?

Concepts:

contributions	plant
life	proper care
method	respect
needs	share

Skills/Processes	**Inquiry:** Generalizing • Summarizing what has been learned about plant needs and caring for plants and formulating rules to be applied when caring for plants. **Language Arts:** Communicating Information • Students have an opportunity to describe proper methods of caring for plants orally to others. A group report can be written to summarize the rules.
Science Attitudes	A-1.21 Respecting each individual life as precious to the individual and others. A-2.24 Respecting the contributions of others to the solution of a problem. • Wanting to care for plants and appreciating the help of others in doing so.
Science Understandings	I-A-1 Each plant has properties that enable the plant to meet its needs. • When certain amounts of light, warmth, and water are provided, plants grow and thrive.

Evaluation Strategy:

Individual

Students are able to describe and demonstrate the proper care of plants.

ACTIVITIES

10. SUMMARIZING PLANT CARE.

Do this activity after Activity 4 has been completed.

Class Discussion:

Select students who have successfully grown and demonstrated proper care of plants. Have them demonstrate proper care of a plant to the class. Also, discuss the effect of not providing proper care, such as overwatering.

If a plant loses water and becomes dry, can it be brought back to life?

How does a plant look when it is not being properly cared for?

What happens when indoor plants are not cared for by people? How about outdoor plants?

If disputes arise over what is the proper care, ask students to judge the conflicting evidence and allow further testing.

Summarize rules for proper plant care in a chart.

1) Water plants regularly, keeping soil slightly moist but not wet.

2) Handle plants gently.

3) Put plants where they will get the proper amount of sun.

4) Planter sticks can be used to help support big plants.

5) Transplant plants when more space is needed to grow.

Additional Optional Discussion:

The following two questions can be used as a basis for a dilemma involving conflict of attitudes.

What would you do if you saw someone pull up a plant that was being cared for by another person?

What would you do if someone was supposed to water your plant for you and forgot to do it?

A class report can be written or orally presented to summarize methods of proper plant care.

SUPPLEMENTARY INFORMATION

Materials:

The results of the experiments on caring for plants from Activity 4.

chart paper

Procedural Note:

Since it is likely that students will still be caring for their planting project (Activity 5) beyond this activity, this activity should serve as a time to establish a concern that the plants continue to be properly cared for by meeting plant needs.

When dealing with dilemmas, it is important to have the students realize that each person might decide differently what to do in a given situation to resolve the dilemma. Each person's personal choice should be guided by defendable reasons.

SYLLABUS EMPHASIS | **ACTIVITIES** | **SUPPLEMENTARY INFORMATION**

Problem:

How do the parts of plants help the plants to live and thrive?

Concepts:

appreciate	plant
live	thrive
needs	use (function)
parts	

Skills/Processes	**Inquiry:** Generalizing • Summarizing the functions of plant parts as found in particular experiments and relating them to plant parts in general. **Language Arts:** Manipulating Ideas • Constructing concise statements that condense information and data from investigations about the functions of plant parts.
Science Attitudes	A-1.1 Appreciating the natural world. • Appreciating the ways in which each plant part helps in maintaining the life of the plant.
Science Understandings	I-A-1.1 The parts of plants have functions that help the plant to live and thrive. I-A-1.11 Roots help plants take in water. I-A-1.12 Leaves help plants utilize sunlight. I-A-1.13 Stems, stalks, trunks, and other similar structures provide support for the plant.

Evaluation Strategy:

Individual

Students are able to identify the plant parts, leaves, roots, and stems and to describe the function of each part.

11. SUMMARIZING PLANT PART FUNCTIONS.

This activity should be conducted after Activities 6, 7, 8, and 9 have been completed.

Class Discussion:

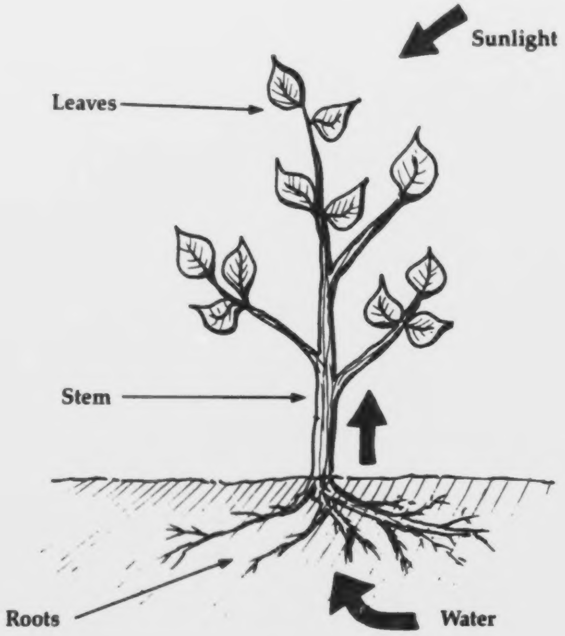
1) Review briefly by having the students recall:

- Activity 6 in which students examined a collection of plants, including their roots, and identified stems, roots, and leaves.
- Activity 7 in which the growth of potatoes was observed and the function of roots discussed.
- Activity 8 in which the reaction of plants to light was studied in an experiment in which plants were put under bags.
- Activity 9 in which the rise of water in plant stems was observed.

On the chalkboard or on chart paper prepare a chart showing the functions of the major plant parts. Ask students to supply the functions.

Other functions may be added if students can convince the class they are true. Question marks may be used to indicate those in doubt.

2) Have students label a drawing such as this to summarize plant part functions.



Materials:

Results from Activities 6, 7, 8, and 9.

Procedural Note:

At this point, students have not gathered any evidence that leaves also exchange gases with surroundings and that roots take in minerals used in the making of food for the plant. Gathering such evidence and making the necessary inferences are probably too difficult for most primary-age children. At this point, they have gathered evidence that these parts serve functions needed for the healthy growth of the plant.

Plant Part	Use For the Plant
roots	support, take in water
leaves	take in sunlight for plant health
stems	support, move water to leaves, position leaves in light

GROWING TIPS

1. Most important! Expose your plants to sunlight as much as possible. The plants should be on the window sill all day long. Plants should not touch the window glass. A window with southern exposure is best. Perhaps you can place your plants in another room periodically if your windows do not face south.
2. Too much water will cause seeds to rot. If mold develops, decrease amount of water. Do not over-water the plants. Yellow leaves or brown stems indicate over-watering.
3. Do not allow the plants to dry out. Keep them at least one foot away from the hot-air ventilator. Brown leaves indicate dry air damage.
4. Do not allow the plants to become too cold. It may be necessary to remove the plants from the window sill at night and over the weekends.
5. Over vacations make arrangements for plant care with your custodian. Sending young plants home is not recommended since they are tender and tend to break in transit. Mature plants should be sent home at the *end* of the school year. (See How To Care For Classroom Plants Over Vacations, below.)
6. Do not plant seeds too close together, particularly beans and peas.
7. Use planter sticks to help hold up tall plants. Use twisters from bread wrappers to hold plants to planter sticks.
8. Plant seeds twice as deep as the seed's diameter.

FIGURE 1

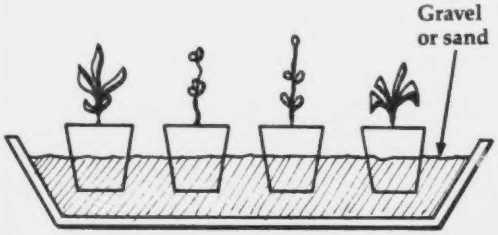
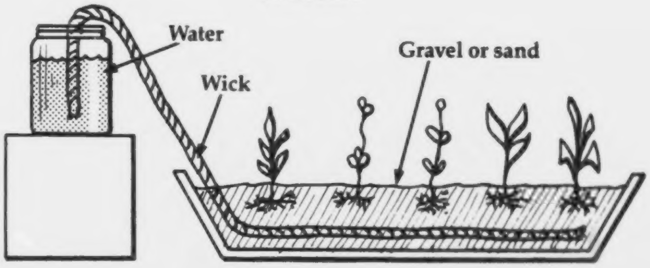


FIGURE 2



HOW TO CARE FOR CLASSROOM PLANTS OVER VACATIONS

Everyone likes school vacation except classroom plants.

The two most important factors in caring for classroom plants during school vacation times are adequate light and the proper amount of water. Place your plants in a location where they will receive adequate light. Listed below are four methods for keeping them properly watered.

1. For small individual planters such as milk cartons, paper cups, and plastic cups with holes in the bottom, partially bury them in a large tray with small stones or sand to a depth of 6 cm. Add 3 cm of water. (See figure 1.)
2. For class gardens use a wick of cotton clothesline run under the potting soil to a jar filled with water. Cover the jar with a lid or plastic wrap to cut down on evaporation. (See figure 2.)
3. For large individual planters, cut and bend coat hangers or other wire into arches to fit the individual planters. Water and cover with a plastic bag. (See figure 3.)
4. For class gardens, cut and bend coat hangers or other wire into arches and place in box at both ends, parallel to each other. Water and cover with a large plastic bag or clear plastic sheeting. (See figure 4.)

FIGURE 3

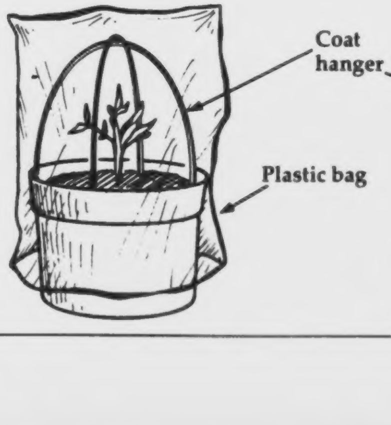
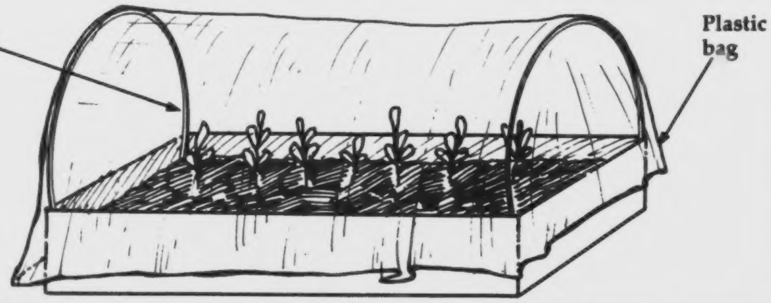


FIGURE 4



I GROWING OLDER

GROWING OLDER

LEVEL I______
(GRADE)

PROBLEM OVERVIEW

What changes take place in a living thing as it grows older? Children, themselves growing older, have a natural curiosity and interest in this process. This curiosity can be used to advantage as the motivating "need to know" for the unit and to focus on the problem. Children can gain an understanding of similarities and differences in patterns of growth and development in living things by studying plants and animals going through the process of growing older.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Emphasis
1	Observing Seedlings	▨	▨					Observing; Recording Data/Questioning A-1.23 Aging process I-A-1.41 Seed, seedling, mature plant
2	Observing Growth of a Young Plant	▨	▨	▨	▨			Observing; Replicating/Questioning A-1.23 Aging process I-A-1.4 Plant growth and development, life-span
3	Changes During the Human Life-Span	▨	▨					Inferring/Developing Vocabulary A-1.23 Aging process I-A-2.41 Infancy to adult stages
4	Observing the Life-Span of an Insect		▨	▨	▨	▨		Inferring/Communicating Information A-2.14 Careful, systematic investigation I-A-2.42 Length of life-span, animals
5	The Length of the Human Life-Span		▨					Generalizing/Communicating Information A-1.23 Aging process I-A-2.42 Length of life-span
6	Recording Plant Growth			▨	▨			Recording Data, Creating Models/Questioning A-2.14 Careful, systematic investigation I-A-1.41 Seed, seedling, mature plant
7	Conditions Affecting Human Life-Span				▨			Hypothesizing/Questioning B-2.2 Benefits of technological change I-A-2.42 Length of life-span, animals
8	Changes During Life-Span of A Plant					▨		Interpreting Data/Communicating Information A-1.11 Complexity, diversity, intricacy I-A-1.4 Plant growth and development, life-span
9	Comparing the Lengths of Plant Life-Spans					▨		Inferring, Interpreting Data/Manipulating Ideas A-1.11 Complexity, diversity, intricacy I-A-1.43 Length of life-spans, plants
10	Observing Changes in Dead Plant Material					▨	▨	Observing/Communicating Information A-1.11 Complexity, diversity, intricacy I-B Plants, animals, dependency
11	Comparing Growth and Development Changes During Life-Spans						▨	Interpreting Data/Manipulating Ideas A-1.23 Aging process I-A-1.4 Plant growth and development, life-span I-A-2.4 Animal growth and development, life-span
12	Comparing Lengths of Life-Spans of Living Things						▨	Interpreting Data/Manipulating Ideas A-1.11 Complexity, diversity, intricacy I-A-1.43 Length of life-span, plants, I-A-2.42 Length of life-span, animals

SUGGESTED APPROACH

In this unit, students have an opportunity to raise a variety of plants through the stages from seed to adult to new seeds and raise mealworms to observe their growth and development stages as they complete their life cycle. The skills, science attitudes, and science understandings developed as a result of the activities in the unit become part of the foundation for more detailed study of life cycles in Level II.

MATERIALS

Plastic bags, clear (quart size, freezer type) – 30 to 60
Paper towels – 30
Seeds: bean – 400; pea – 400; marigold – 30; corn – 30
Egg carton, plastic (dozen size – discarded) – 30
Milk cartons (half gallon size – discarded) – 30
Potting soil (approximately 5 cubic feet)
Trays (cafeteria) or shallow boxes – 3 or 4
Plastic sheets (liners) 3 or 4
Hand lenses – 15 to 30
Oak tag
Photos of people (various ages) brought from home
Obituary columns (from large city newspaper)
Construction paper
Plant material samples (bread, fruit, vegetables)
Plastic containers – clear, hard, with cover (discarded food containers) – 30; or plastic freezer bags above
Rulers (with centimeter scale) – 30
Bran flakes – 30 cups
Potatoes (or apples) – 8 to 10 whole
Mealworms – 5 per student

MORE IDEAS

1. Students may select ("adopt") a tree on the school grounds or in the neighborhood and record observations of the seasonal change that take place.
2. Discuss the following:
   a) When do trees rest?
   b) Did the pea and bean plants rest?
   c) Do adults grow?
   d) What is the difference between sleep and hibernation?
3. Students may collect other insects such as moth or butterfly larva and observe their life span. Compare to the life span of the mealworm.
4. Have students draw pictures predicting what mature plants will look like (e.g., size, flower, leaves). Save pictures and compare with actual mature plant. Seeds need not be identified prior to planting.
5. Students mark dates of planting on a calendar and may predict when their seeds will germinate. Compare rates of germination.
6. Language Experience Charts: Suggested titles – We Planted, We Wonder, How Our Garden Grows, How Our Mealworms Change.
7. Students may make a daily record book, etc., that they have to keep. These may be used for display.
8. Invite local Humane Society personnel to visit classrooms with animals.
9. Students may write a diary for a growing mealworm from the mealworm's point of view.
10. Students may act out or pantomime the life of a growing seed.
11. Read to class the book, "The Tenth Good Thing About Barney," by Judith Viorst.

SYLLABUS EMPHASIS **ACTIVITIES** **SUPPLEMENTARY INFORMATION**

Problem:

How does a plant start to grow older?

Concepts:

germinate
growth
observe
plant
seed
seedling

Skills/Processes	**Inquiry:** Observing/Recording Data • Students observe changes in germinating seeds and record seed growth. **Language Arts:** Questioning • Questions are identified that help clarify the problem.
Science Attitudes	A-1.23 Accepting the aging process of all living things as continuous and natural. • In the natural world a seed is a part of life that is maturing.
Science Understandings	I-A-1.41 Stages of development in some plants include seed, seedling, and mature plant. • Seeds are the beginning step of growth and development in some plants.

Evaluation Strategy:

Program

Students are able to construct and maintain germination bags and make observations of seedling growth.

1. OBSERVING SEEDLINGS.

Assemble the germination bags as shown in the figure below. As seeds germinate, students should observe changes. A record of the growth can be made daily by drawing a picture of the developing plant on an activity sheet such as the one shown at the right.

Class Discussion:

Ask the class what kinds of questions should be asked and answered to help solve the problem. Lead them to the type of questions listed below. These should be discussed as the germination and growth continue.

What part appears from the seed first?

How do small seedlings differ from each other?

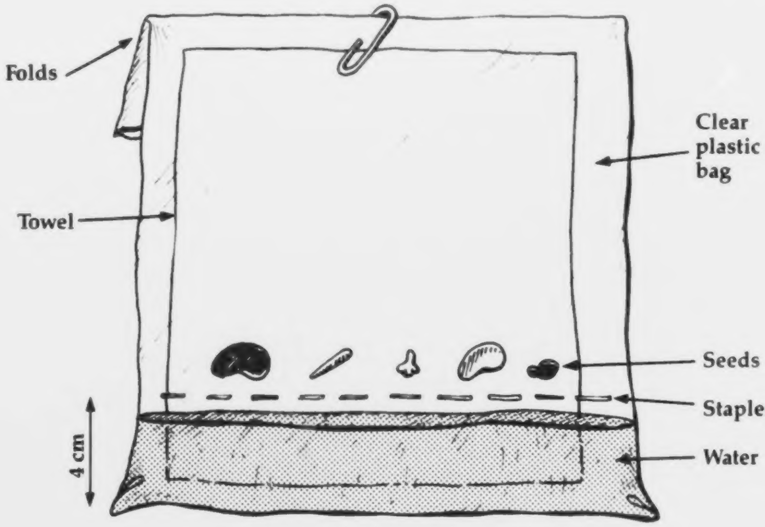
How are they the same?

How does the rate of growth of the seedlings compare?

What happens to the appearance and location of the "old seed" as the seedling grows?

Can the growth of seedlings be stopped without causing them to die?

Students can transplant the seedlings to cups of potting soil to keep them alive and then use proper methods to care for them. See Growing Tips on page 71.



Materials:

For each student:

1 freezer plastic bag
1 paper towel
1 seed each: bean, marigold, corn, pea
1 activity sheet
Masking tape
Water

Procedural Note:

It may be necessary to review the process of assembling germination bags. Students may have done this type of activity earlier in this science experience.

Date ______

Date ______

Date ______

Date ______

Date ______

Date ______

Date ______

Daily Growth Activity Sheet

Problem:

What changes can be observed in a young plant as it grows?

Concepts:

height
leaves
plant
roots
stem

Skills/Processes	**Inquiry:** Observing, Replicating • An opportunity to review proper methods to care for plants and apply them in starting seeds. **Language Arts:** Questioning • Students can brainstorm questions useful in solving the problems for the activity.
Science Attitudes	A-1.23 Accepting the aging process of all living things as continuous and natural. • Marveling at the growth and development of the plants.
Science Understandings	I-A-1.4 Each kind of plant goes through its own stages of growth and development during the life span of the plant. The length of time from beginning of development to death of the plant is called its *life-span*. • Some plant life-spans are shorter than others.

Evaluation Strategy:

Group

Students are able to identify and describe changes in plants as a result of growth and development.

2. OBSERVING GROWTH OF A YOUNG PLANT.

Each student should count out 12 seeds and plant one in each section of a plastic egg carton or other suitable container. See Growing Tips on page 72.

At the end of each of the first three weeks, have students draw a picture of their favorite plant from among those growing. All details should be included, such as the correct number of leaves. The picture can be drawn on an activity sheet similar to the one shown in the figure at the right.

Students should mark the height of the plant on the chart similar to the way their own height might be marked on a wall chart as a record over time.

Class Discussion:

At the end of each of the first three weeks, conduct a discussion about the progress of the plants. Stimulate discussion by having students think of questions that could be discussed and shared at this point, such as the following:

Which seeds (of the 12) grew?

When you gave the same care to all of the seeds, did they grow the same way?

How many leaves does your favorite plant have?

How have the leaves on the plant changed since they first appeared or in the last week?

Do the plants seem to be growing faster or slower?

What could be the reason that some plants did not grow at all, or died before reaching full growth?

To answer these questions, students can dig up any ungerminated seeds or dead plants and inspect them. If there is some indication germination might still occur, the seed can be carefully replanted. Otherwise the dead material can be collected for Activity 9.

How have the roots changed as the plant grows?

To answer this question, students can remove their poorest growing plant. Soil can be gently removed by shaking or rinsing. Roots can be examined for detail. This information can be added to the picture. The plant can be replanted if the students wish or added to the dead plant material being collected for Activity 10.

When the healthiest plants are about 10 centimeters tall, transplant them to larger containers such as cut off 1/2 gallon (two liter) size milk cartons, shown at the right. Other plants could be transplanted in a class garden or, if appearing to be dead, can be collected for Activity 10.

Materials:

For each student:

1 egg carton, plastic (one-dozen size)
12 (pea or bean) seeds
Potting soil
1 discarded 1/2 gallon (two liter size) milk carton
Activity sheets

For the class:

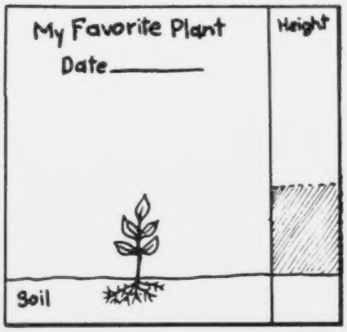
Class size garden OR
Shallow lined trays to hold student milk carton planters
Hand lenses

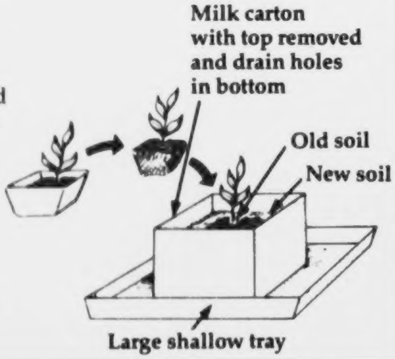
Procedural Notes:

1) Proper method for planting seeds and proper care needed by the plant may have been learned in an earlier science experience. It may be necessary to review these procedures for this activity.

2) The picture records should be kept by the students in a folder to be used in Activities 8 and 10.

3) Students should be able to record their observations through other means if unable to draw.




Milk carton with top removed and drain holes in bottom
Old soil
New soil
Large shallow tray

Problem:

How do people change as they grow older?

Concepts:

adult
baby
care
children
grandparent
middle age
old
senior citizen
young

Skills/Processes	**Inquiry:** Inferring • Some changes in people we can observe; other changes we can infer. **Language Arts:** Recording Data • A picture record can be used to help visualize information.
Science Attitudes	A-1.23 Accepting the aging process of all living things as continuous and natural. • Expressing interest in how much alike and different people are as they grow older.
Science Understandings	I-A-2.41 Animals go through a particular set of stages from young to adult. • People change in size and in many other ways as they grow older.

Evaluation Strategy:

Group

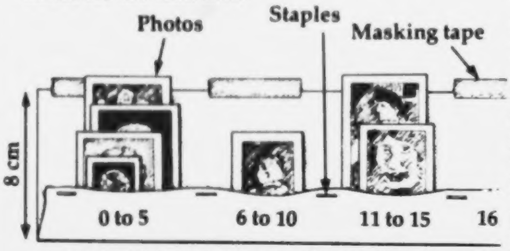
Students are able to make observations and inferences about photos of people at various ages.

3. CHANGES DURING THE HUMAN LIFE-SPAN.

Preparing a Time Line

Mark off a long chalk tray in 15 cm wide sections and label the age for each section, counting by five's. This will serve as a time line along which to place photos. A long tray similar to the chalk tray can be made with strips of folded oak tag and stapled every 15 cm's to form pockets, fastened together, and taped to a wall. You will probably need a time line 100 years long. This will require a picture tray about three meters long.

Broad life-span categories such as "baby," "child," "teenager," "young adult," "middle aged," and "senior citizen" might be used as labels for the time line.



TIMELINE IN 5 YEAR INTERVALS

As photos are brought in, ask students to look at the people in them without knowing the age and guess where they should be placed on the time line. As more photos go up, the guesses should get better. Teach children to hold photos gently by their edges.

When a number of photos are in for many age categories, gather the students together in front of the time line and conduct a discussion.

Class Discussion:

What changes have occurred to people from one place in the time line to a later place?

Which people in the photos are at an age when they are probably providing care for others?

Which ones are probably being cared for by others?

Which are probably going to school?

Which are retired?

Which cannot walk?

Which might be married?

Which might drive a car?

Which might be parents? Grandparents?

Which ones probably have learned the most? Is there any age when people are:

> Smoothest skinned? Most grey haired? Baldest? Happiest? Most Interesting? Most active? Needing the most care by others? Wisest? Smartest? Healthiest?

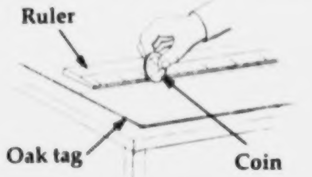
Materials:

Photos of people at various ages
Oak tag
Tape
Staples

Procedural Notes:

Prepare for a later class session by asking students to bring in photos from home of themselves, their brothers and sisters, parents, grandparents, or other friends and relatives; include baby pictures. All photos will be returned and should be marked on the back to identify the owner. The one restriction is that the age of the person in the photo must be known and should be marked on the back. Photos with only one person in them are preferred. The names of people in the photos are not needed. Several photos of one person at different ages are ideal. Pictures cut from magazines can be used to supplement the personal photo collection. Pictures could depict persons of varying cultures, ages, sex and disabilities. Reasons can be discussed for classifying the photos.

Oak tag should be creased before folding by running a coin along the line where it will be folded, using a ruler as a guide.



Although some of these questions have answers on which all can agree, many do not, and answers to these can usually be used to point out how people can be quite different even though they are at the same age or how people can be the same at different ages. The point that knowing the age and what a person looks like does not tell you other things such as happiness, smartness, activeness, etc., can also be made.

IMPORTANT: Save the photo time line for Activity 7.

SYLLABUS EMPHASIS

Problem:

What changes occur in a mealworm during its life span?

Concepts:

adult	form
beetle	growth
change	larva
development	life span
egg	pupa

Skills/Processes	**Inquiry:** Inferring • Mealworm behavior may be inferred from observations of their activity. **Language Arts:** Communicating Information: • The story of the life of a mealworm can describe the details and sequence of the insect's growth and development.
Science Attitudes	A-2.14 Valuing careful, systematic investigation as useful in resolving issues. • When faced with new findings such as shed skin, students have an opportunity to conduct systematic investigations to answer questions about the changes.
Science Understandings	I-A-2.41 Animals go through a particular set of stages from young to adult. • A mealworm changes from egg to larva to pupa to adult beetle before a new generation is produced in its lifespan.

ACTIVITIES

4. OBSERVING THE LIFE-SPAN OF AN INSECT.

Have each student half fill a clear plastic sandwich bag or clear hard-plastic container with bran flakes and add five mealworms to it. A small piece of apple or potato should be added to provide food and moisture. The container can then be taped closed and fastened to the side or top of the student's desk. Students should observe their mealworms periodically for the next four weeks. They may want to spend some time now observing the mealworms and describing their behavior. Students should make a full-page, detailed drawing of their favorite mealworm, date the picture, and save it. To keep a record of growth, students may want to mark the length of each mealworm on a piece of paper and date the record, similar to the plant growth record in Activity 2.

At some point during the growth of the mealworms, a student may notice a skin from a molting mealworm and be puzzled about it. To help solve this problem, have each student mark the back of at least one mealworm with a permanent marker, and from then on examine and discard each skin found. When at some point students discover the marked shed skin, a brief discussion should be held about why mealworms shed their hard skin. After a few weeks or even days, depending on the starting age of the mealworm, a pupa should appear. Be sure students are aware that they still have the same number of individuals in the container, although the form of some has changed. Have students draw a detailed, full-page drawing of a pupa, and date and save the picture. Some days later, depending on condition, the brown adult beetle emerges from the pupal case. The beetle soon turns black, lays eggs, and dies. Have students draw a detailed full-page drawing of an adult beetle, and date and save the picture. Students should be given time to investigate the behavior of each form of mealworm as it appears. Dumping the contents of the bag on a tray helps in this process. Introduce the name of each form as it is studied. (Mealworm, pupa, adult.)

Class Discussion:

What forms does the mealworm go through during its life span? How does each form of mealworm differ in appearance and behavior? In which form does the mealworm eat the most and grow the most? In which form does the mealworm rest?

SUPPLEMENTARY INFORMATION

Materials:

Mealworm culture for class (five mealworms per student)
1 plastic freezer bag or sealable clear hard-plastic container
Bran flakes
Potato or apple pieces for each container
Magnifiers

Procedural Notes:

1) Mealworms are harmless. They are not able to crawl out of plastic containers. Adult mealworm beetles cannot crawl or fly out of plastic containers. Students should not be forced to handle mealworms, and the activity can be completed without anyone having to handle the mealworms. Most squeamish students will overcome their fear of the insect if their attempts to gain attention by being squeamish are ignored by the teacher and other students. Be careful not to convey your own squeamishness if it exists. This activity provides an excellent opportunity to encourage humane treatment of animals.

2) You may wish to have a discussion of how students might keep a record of mealworm growth and suggest the use of pictures.

3) Students sometimes think the shed skin is a dead mealworm. The skin of the mealworm is hard and does not stretch; therefore, mealworms must shed their outer skin (molting) several times before reaching full size. The new skin is slightly larger and allows for more growth of the mealworm.

4) Avoid telling students what changes to expect as the mealworms go through their lifespans.

5) The details and sequence of mealworm growth and development can be summarized in a written class report. The complete life cycle will be introduced in Level II of the syllabus.

SYLLABUS EMPHASIS Cont'd

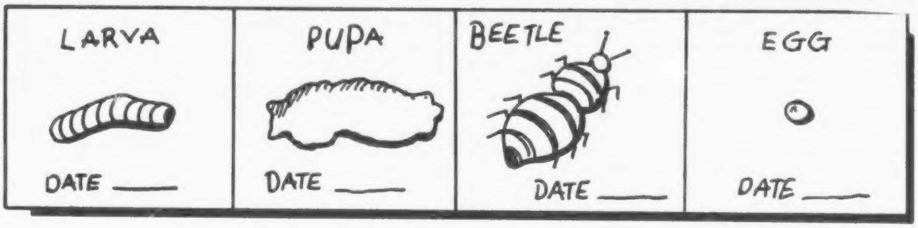
Evaluation Strategy:

Group, Program

Students are able to assemble mealworm containers, observe changes as the insects grow and develop, and describe their observations and inferences about the changes.

ACTIVITIES Cont'd

Have students tape their pictures of the mealworm forms together to make a foldout similar to that shown below. Save this fold- out for Activity 10.



SUPPLEMENTARY INFORMATION Cont'd

6) A large culture can be maintained in a shoe-box-size container of bran flakes with potato or apple halves for food.

7) Mealworms may be disposed of by feeding them to amphibians, reptiles, or fish, or by putting them in a freezer for 24 hours.

8) Students should be allowed to record salient characteristics of the mealworm through alternative means if unable to draw.

SYLLABUS EMPHASIS **ACTIVITIES** **SUPPLEMENTARY INFORMATION**

Problem:

How long do people live?

Concepts:

age
average
chart
compare
life span

Skills/Processes	**Inquiry:** Generalizing • Conclusions can be drawn about the life-span of humans from recorded information. **Language Arts:** Acquiring Information • Information needed for solving problems can be obtained from written records.
Science Attitudes	A-1.23 Accepting the aging process of all living things as continuous and natural. • Children can begin to develop awareness and feelings about the aging process.
Science Understandings	I-A-2.42 Animals have life-spans of varied length. • Humans have various length life-spans, but some lengths seem to be more common than others.

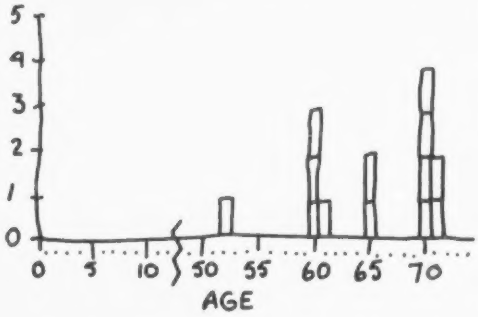
Evaluation Strategy:

Group

Students are able to make an analysis of data to determine the age to which "most people" seemed to live.

5. THE LENGTH OF THE HUMAN LIFE-SPAN.

The class should construct a histogram chart on the chalkboard, using the obituary notices from the newspaper. Ages should be marked on the chart as shown in the figure below.



Class Discussion:

According to the chart:

To what age did at least half of the people live? What is the longest life-span?

To what single age did most people live? Explain to the students that the chart represents only 50 individuals. What do they think the results would be if more were listed?

If time and interest permit, additional entries could be made.

Students might also wonder whether men or women live longer. Have students code entries "Male" or "Female" so that they can look for patterns.

Materials:

Obituary columns from a large city newspaper or an out-of-town newspaper. At least 50 obituaries are needed. Names should be deleted.

Procedural Notes:

1) Names should be deleted in use of the obituary because the only interest is finding the length of the life-span of individuals.

2) Keeping in mind that the objective of this activity is to find out and develop a sense of the age to which people can live, you might be able to find alternative sources of ages to which people live, other than death notices. A trip to a cemetery, a library search of the ages at which famous people died, or asking students to find out the ages of their great-grandparents or the ages at which their great-grandparents died, are a few ways, one of which you might feel can be handled without raising sensitive issues about human death.

3) The histogram chart will probably have to span ages from 0 to 100. Each year can be constructed two cm wide; thus, the chart will need to be about two meters long. The chart will provide a picture for both the frequency and time length comparisons.

4) The use of death notices should be carefully used in classes where students have experienced a recent death. Other means such as demographic data or family trees could be used.

SYLLABUS EMPHASIS

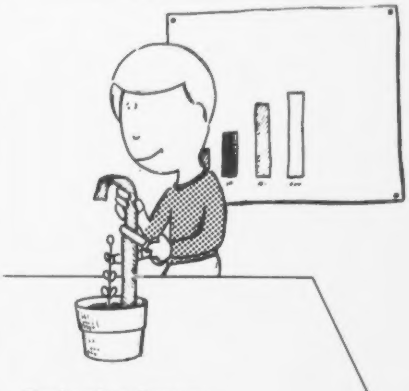
Problem:

How fast do plants grow?

Concepts:

cooperate
graph
grow
height
measure
predict
record

Skills/Processes	**Inquiry:** Recording Data/Creating Models • Students collect measurements of plant height and organize them into a bar graph. **Language Arts:** Questioning • Students raise questions to help decide on proper methods to obtain information and organize it.
Science Attitudes	A-2.14 Valuing careful, systematic investigations as useful in resolving issues. • More success is obtained in predicting plant growth when careful observations and accurate records are made.
Science Understandings	I-A-1.41 Stages of development in some plants include seed, seedling, and mature plants. • Seedlings grow into mature plants over time.



Evaluation Strategy:

Group, Program

Students are able to suggest and apply methods to use in demonstrating how fast plants grow.

ACTIVITIES

6. RECORDING PLANT GROWTH.

As weekly discussion is being conducted on Activity 2, students may become interested in how much the plants will grow day by day.

How fast do the plants grow? Lead a discussion to help the students decide on a method to answer the question. The record of height made during the first three weeks is a good starting point.

Help students realize they will need a record of the plant height for each day. How can this be done? Students may want to use more copies of the Activity Sheet used in Activity 2. Suggest the use of strips of paper to represent the height. The records of plant height collected for several days will need to be organized in some way to answer the question. How can this be done?

Give each student strips of colored construction paper (or have them cut strips from a sheet) to use for measuring the height of the plant. The student should hold one paper strip up to their favorite plant (from Activity 2) and cut off the strip at the height of the plant. The strip should be labeled with a number or the date.

Strips collected each day can be organized according to the method discussed and shown in the figure at the right.

Ask the students to make a prediction to answer the question, "How tall will your plant be tomorrow?" Have students mark a strip (or their graph) to represent their prediction. On the next day have the students report on the accuracy of their prediction.

Class Discussion:

Do plants grow the same amount each day? How can you tell?

If your plants grew in spurts, can you tell why?

Why do some plants grow faster than others?

If two plants are taken care of in exactly the same way, will they be exactly the same height after growing for one month?

How fast do people grow?

Do some children grow faster than others?

Do you think you grow a little each day?

If the plants keep growing as they are, will they be as tall as you one week from now? One month? One year from now? This question is advanced for primary-age children and should be asked only to suggest problems in long-range predicting.

SUPPLEMENTARY INFORMATION

Materials:

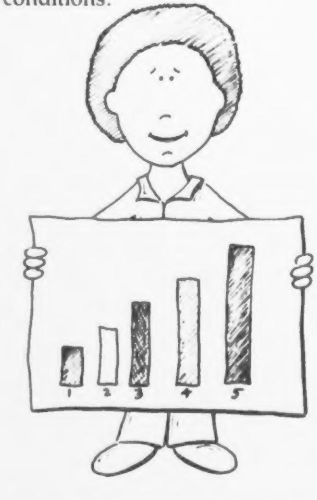
For each student:

1 favorite plant from Activity 2
1 sheet of construction paper or strips precut
Scissors
1 sheet of chart paper

Procedural Notes:

1) From previous experience with graphing, students may suggest a proper method to organize a bar graph. If this experience is lacking, it may be desirable to let the question of how to organize the record become a sub-problem. This can lead to realizing a need to organize data systematically.

2) While each student should make a personal record of plant height, having the students work in pairs could help achieve the task and teach some cooperation as well. When students are selected to work in pairs, teachers should carefully consider the individual needs of students with handicapping conditions.



3) The predicting activity can be repeated in several days if necessary to increase the chances of success in predicting.

4) Students may want to start a record of their growth, if this is not already being done.

SYLLABUS EMPHASIS **ACTIVITIES** **SUPPLEMENTARY INFORMATION**

Problem:

How do the lengths of human life spans compare for different times in history and different places in the world?

Concepts:

age
average
conditions
graph
length
life span
time line

Skills/Processes	**Inquiry:** Hypothesizing • Students can speculate on the effects of changes in living conditions on life spans in the form of simple statements such as, "If more medicine were available, then…." **Language Arts:** Questioning • Students raise questions and try to answer them about data presented to them.
Science Attitudes	B-2.2 Valuing the benefits that technological change may have on people and the environment. • Expressing appreciation about the benefits which technological change may have on human life spans. • Expressing ideas on how technology can assist handicapped individuals in accomplishing the same tasks as nonhandicapped peers.
Science Understandings	I-A-2.42 Animals have life-spans of varied lengths. • Some humans have longer life-spans than others.

Evaluation Strategy:

Group

Students are able to identify the age to which "most people" lived on the time lines.

7. CONDITIONS AFFECT THE HUMAN LIFE-SPAN.

Show students time lines you have drawn on chart paper for the age "most people" lived to at three different times, such as shown at the right. Compare this information to the age to which "most people seemed to live" identified in Activity 5.

Class Discussion:

Conduct a discussion with the students to help them raise and answer questions about the information, such as:

How is the length of the human life-span changing in the United States?

What are some possible causes for the change?

Brainstorming could be conducted which might identify causes such as: better food, control of sickness, more and better doctors, vaccinations, better medicine, better surgery, better sanitary conditions.

Show students time lines you have drawn for the age to which "most people" live in three different areas of the world today.

Class Discussion:

How does the length of the human life-span in other places in the world compare to our country?

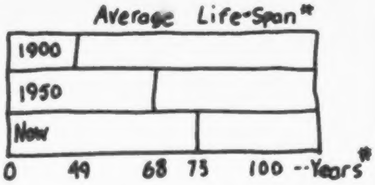
What might explain differences? (See discussion ideas above.)

What would happen to the length of the human life-span in an area if conditions changed?

Materials:

Time-line charts for United States and several foreign areas.

Results from Activity 5



*Up-to-date figures are available under vital statistics in most world almanacs.

	Average Life-Span
United States	73
Congo	44
Brazil	61

It is not important that students understand where the places are but only that they are far from each other.

The places might be pointed out on a globe or world map or described in terms of how long it would take to travel to them by airplane.

SYLLABUS EMPHASIS

Problem:

How do plants change as they grow older?

Concepts:

adult plant
changes
development
flowers
growth
leaves
life span
roots
seeds
stem

Skills/Processes	**Inquiry:** Interpreting Data • The details of plant development can be interpreted from the recorded information. **Language Arts:** Communicating Information • A story can be written describing the details and sequence of the growth and development changes in a growing plant.
Science Attitudes	A-1.11 Appreciating the natural world, its complexity and diversity, its lawfulness and consistency, and its intricate detail and vastness. • Appreciating the orderliness of the development of plant parts as a plant grows to maturity.
Science Understandings	I-A-1.4 Each kind of plant goes through its own stages of growth and development during the life-span of the plant. The length of time from beginning of development to death of the plant is called its *life-span*. • Pea plants or bean plants develop specific parts as they grow to maturity.

Evaluation Strategy:

Individual

Students are able to describe parts that develop on the growing plants and place the development in a correct sequence.

ACTIVITIES

8. CHANGES DURING THE LIFE-SPAN OF A PLANT.

As the plants started in Activity 2 reach maturity, students should have had the opportunity to record on the activity sheet the appearance of plant parts including stem, leaves, roots, flowers, and new seeds.

The pictures prepared each week can be fastened together as a foldout in chronological order. This can be used as part of the information, along with the mature plant, for a class discussion.

Class Discussion:

What changes have been observed in the growing plant?

What new parts appeared? When did each part first appear?

Does a healthy plant ever stop growing?

What is the length of the life-span of the plant?

As a concluding activity, the class can prepare a written story describing the life-span of their favorite plant.

SUPPLEMENTARY INFORMATION

Materials:

Records from Activities 2 and 6.
Mature plant from Activity 2.

Procedural Note:

It may be useful to draw attention to the differences, similarities, and interdependencies in nature. (See Science Attitude A-1.11.)

SYLLABUS EMPHASIS

Problem:

How long do plants live?

Concepts:

compare
growth
infer
life-span
oldest
youngest

Skills/Processes	**Inquiry:** Inferring Interpreting Data • Evidence found in trees enables estimates to be made of their age. **Language Arts:** Manipulating Ideas • Inferences about a plant's (tree's) life-span can be summarized into concise statements.
Science Attitudes	A-1.11 Appreciating the natural world, its complexity and diversity, its lawfulness and consistency, and its intricate detail and vastness. • Marveling at observations made about trees.
Science Understandings	I-A-1.43 Plants have life-spans of varied length. • Bean or pea plants have shorter life-spans than trees.

Evaluation Strategy:

Group

Students are able to make observations of plants in the out-of-doors and state inferences comparing the length of life-spans of the plants.

ACTIVITIES

9. COMPARING THE LENGTHS OF PLANT LIFE-SPANS.

Take a walk with the class to the edge of or into a wooded area. Students should observe the plants (grasses, shrubs, trees, etc.),looking for parts growing on these plants that are similar to their favorite plant growing in the classroom. (Leaves, stems, flowers, seeds, etc.) Such walks should be made accessible to students with handicapping conditions.

Ask students to look for very young plants (babies or infants), young plants, and old (mature) plants. Can any plants be found which are dead or that have dead parts?

After students have had time to make their observations and choices, conduct a discussion.

Class Discussion (in the field):

Which plants seem to be the youngest? Which seem to be the oldest? How did you decide on your choices? Does everyone agree? Why? Which of the plants seem to live more than a year? How do we know? How long does a plant like our favorite classroom plant (pea or bean) live compared to a tree? Can plant parts die without the entire plant dying? What evidence can we find to support our answer?

It may be desirable to introduce the idea of annual compared to perennial plants.

How can you determine the age of a tree? If a stump or slice of wood is available, show students the rings in the cross section. If the rings are clearly visible, let students count the rings. Explain that each ring is made by one year of growth. How many years does the piece of wood seem to have grown?

How does the size (thickness) of the rings compare? Does the tree seem to have grown the same amount each year?

Explain that most trees grow about one centimeter larger (diameter) each year. If this is true, then how old are the trees we have observed? Measurements can be taken of the "oldest" tree or of the samples whose rings have been studied to arrive at an estimate of the age. After the class returns to the classroom, statements can be written to summarize the findings comparing length of plant life spans.

SUPPLEMENTARY INFORMATION

Materials:

Rulers (centimeter scale)

Procedural Notes:

1) This activity can provide part of the exposure to the problem explored in Activity 10 about changes in dead plant material.

2) If a field trip is not possible, other alternatives such as media materials or a class visitor talking about ages of trees and other plants could be substituted.

The terms "annual" and "perennial" need not be used, but the idea of this variation can be discussed.

SYLLABUS EMPHASIS

Problem:

What happens to the material of plants after they die?

Concepts:

changes
dead plant material
decompose
mold

Skills/Processes	**Inquiry:** Observing • Changes take place in dead plant material that are observable. **Language Arts:** Communicating Information • The details and sequence of changes in the decomposition of dead plant material can be written in a story or shown in pictures.
Science Attitudes	A-1.11 Appreciating the natural world, its complexity and diversity, its lawfulness and consistency, and its intricate detail and vastness. • Appreciating that there is an orderly process that returns dead plant material to the soil.
Science Understandings	I-B Plants and animals are dependent on other plants and animals. • The living mold seems to depend on material of the dead plant as a source of food.

Evaluation Strategy:

Group

Students are able to observe and describe changes in appearance of decomposing plant material.

ACTIVITIES

10. OBSERVING CHANGES IN DEAD PLANT MATERIAL.

Have students place samples of plant material and the collected dead plant material from earlier activities in clear plastic bags or clear hard-plastic containers. The materials should have been exposed to the air for 30 minutes before placing them in the containers. The containers should be tightly sealed.

Do not open or allow students to open these containers again. Label the containers

DO NOT OPEN.

After a few days, mold plants should begin to develop on some of the samples.

Students should make daily observations and record any changes that occur. Conduct a class discussion about the effect of the mold in changing and decomposing the dead plant material.

Class Discussion:

What is happening to the plant materials in the containers?

What similar changes may be occurring at home?

What similar changes may be happening in the out-of-doors?

SUPPLEMENTARY INFORMATION

Materials:

Samples of plant material such as pieces of bread, fruit, vegetables

Collected dead plant material from unit activities

Plastic bags or clear hard-plastic containers

Safety Note:

The containers of decomposing plant material should be disposed of without opening them or exposing students to their contents.

Problem:

How do the life-spans of various plants and animals compare?

Concepts:

appearance
care
change
compare
forms
life-span

Skills/Processes	**Inquiry:** Interpreting Data • Results of many observations provide information that can be interpreted about changes in living things. **Language Arts:** Manipulating Ideas • Information gathered and interpreted can be summarized in the form of statements.
Science Attitudes	A-1.23 Accepting the aging process of all living things as continuous and natural. • Expressing feelings about all living things changing as they age and that they will eventually die, and that this is natural.
Science Understandings	I-A-1.4 I-A-2.4 Each kind of plant (and animal) goes through its own stages of growth and development during the life-span of the plant (or animal). The length of time from beginning of development to death of the plant (or animal) is called its *life-span*. • All living things have a life-span.

Evaluation Strategy:

Individual, Group

Students are able to summarize and describe the general characteristics of the stages of growth and development of the four life forms studied.

11. COMPARING GROWTH AND DEVELOPMENT CHANGES DURING LIFE-SPANS.

Review with the students the results of the earlier activities.

Activity 2 – grew a plant (bean or pea) and observed growth and development.

Activity 3 – observed changes in humans of different ages from photos.

Activity 4 – observed changes in mealworms during their growth and development.

Activity 8 – analyzed changes in plant growth and development.

Activity 9 – collected information and made inferences about growth and development of trees.

Class Discussion:

Help students compare the life-spans of a plant (bean or pea), a mealworm, the human, and a tree. Ask comparative questions such as:

Which ones (bean, mealworm, human, tree) have forms which move about?

Which ones have forms which are cared for by older forms?

Which ones change in appearance the most?

For each of the four kinds of living things studied:

During which form does the living thing undergo the greatest change in size?

What is the first form of each like in size, needs, and activities?

During which form *can* death occur?

During which form *must* the life-span end be reached?

General Summary:

Do all living things have a life-span?

Do living things of a certain type go through similar forms during their life-span?

Library or media activity may be desirable for the students to create additional examples of the changes during the life-span of other living things, such as a dog, cat, fish, bird, potato, tulip, lawn grass, or dandelion.

Materials:

Results from Activities 2, 3, 4, 8, and 9.

SYLLABUS EMPHASIS

Problem:

How do the lengths of life-spans compare?

Concepts:

compare	life-span
largest	smallest
length	time line

Skills/Processes	**Inquiry:** Interpreting Data • Patterns can be found in data about life-spans of living things. **Language Arts:** Manipulating Ideas • Statements can be written that summarize interpretations about length of life-spans.
Science Attitudes	A-1.11 Appreciating the natural world, its complexity and diversity, its lawfulness and consistency, and its intricate detail and vastness. • Marveling at the wide variation of life-spans of living things. • Acknowledging the differences, similarities and interdependencies in nature.
Science Understandings	I-A-1.43 I-A-2.42 Plants (and Animals) have life-spans of varied length. • The life-span of various plants and animals, including humans, ranges from a short time compared to humans to a very long time compared to humans.

Evaluation Strategy:

Group

Students are able to make accurate comparisons of the lengths of life-spans of various animals and plants.

ACTIVITIES

12. COMPARING LENGTHS OF LIFE-SPANS OF LIVING THINGS.

Raise the problem question with the class. Ask how they might go about seeking an answer to it.

Help students realize some information has already been obtained from earlier activities.

Brainstorm a list of possible sources of information such as library books, media materials, and other people.

Use as many of these sources as possible and convenient to obtain information for a time line.

Construct a time-line chart, with student help, on the chalkboard. The line should represent a span of at least 300 years in which each centimeter is equal to one year.

As new information about the life-span of a plant or animal is obtained, it should be added to the time line. The names of the plants and animals should also be included, as well as a picture whenever possible. When sufficient numbers of animals and plants have been added to the time line, conduct a class discussion.

Class Discussion:

What is the life-span for most vegetables?

What is the life-span for most insects?

How does the human life-span compare to other living things?

Do larger living things live longer than smaller living things?

What living thing seems to have the longest life-span?

What living thing seems to have the shortest life-span?

Seeds found in graves or tombs thousands of years old have grown when planted. Should this time be included in their life-span?

SUPPLEMENTARY INFORMATION

Materials:

Results from earlier activities.

GROWING TIPS

1. Most important! Expose your plants to sunlight as much as possible. The plants should be on the window sill all day long. Plants should not touch the window glass. A window with southern exposure is best. Perhaps you can place your plants in another room periodically if your windows do not face south.
2. Too much water will cause seeds to rot. If mold develops, decrease amount of water. Do not over-water the plants. Yellow leaves or brown stems indicate over-watering.
3. Do not allow the plants to dry out. Keep them at least one foot away from the hot-air ventilator. Brown leaves indicate dry air damage.
4. Do not allow the plants to become too cold. It may be necessary to remove the plants from the window sill at night and over the weekends.
5. Over vacations make arrangements for plant care with your custodian. Sending young plants home is not recommended since they are tender and tend to break in transit. Mature plants should be sent home at the *end* of the school year. (See How To Care For Classroom Plants Over Vacations, below.)
6. Do not plant seeds too close together, particularly beans and peas.
7. Use planter sticks to help hold up tall plants. Use twisters from bread wrappers to hold plants to planter sticks.
8. Plant seeds twice as deep as the seed's diameter.

FIGURE 1

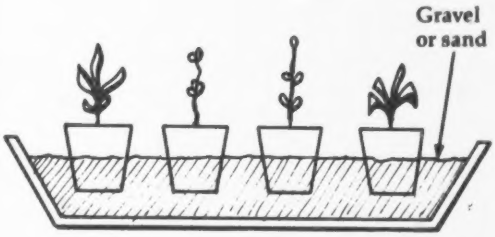
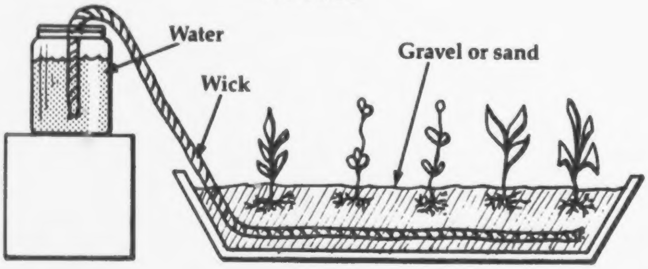


FIGURE 2



HOW TO CARE FOR CLASSROOM PLANTS OVER VACATIONS

Everyone likes school vacation except classroom plants.

The two most important factors in caring for classroom plants during school vacation times are adequate light and the proper amount of water. Place your plants in a location where they will receive adequate light. Listed below are four methods for keeping them properly watered.

1. For small individual planters such as milk cartons, paper cups, and plastic cups with holes in the bottom, partially bury them in a large tray with small stones or sand to a depth of 6 cm. Add 3 cm of water. (See figure 1.)
2. For class gardens use a wick of cotton clothesline run under the potting soil to a jar filled with water. Cover the jar with a lid or plastic wrap to cut down on evaporation. (See figure 2.)
3. For large individual planters, cut and bend coat hangers or other wire into arches to fit the individual planters. Water and cover with a plastic bag. (See figure 3.)
4. For class gardens, cut and bend coat hangers or other wire into arches and place in box at both ends, parallel to each other. Water and cover with a large plastic bag or clear plastic sheeting. (See figure 4.)

FIGURE 3

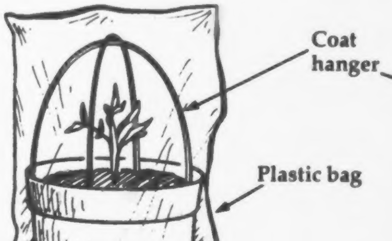
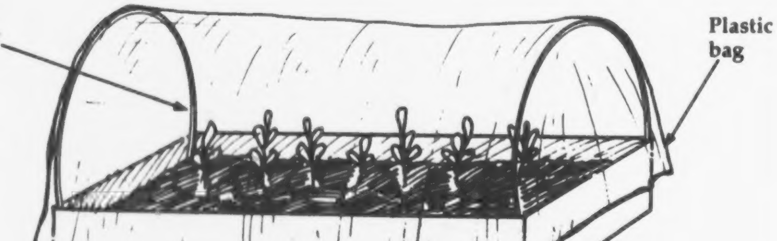


FIGURE 4



I

SWINGS

"HOW DO THEY MOVE?"

SWINGS – "HOW DO THEY MOVE?"

LEVEL I ____________
(GRADE)

PROBLEM OVERVIEW

The common playground swing is part of most school children's experience. While the primary function of the playground swing is for recreation, it can also become a device for scientific study of pendulum effects. Many questions about how swings (pendulums) operate may already exist in the minds of curious children or may be raised as a natural outgrowth of the experience of riding on a swing.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Emphasis
1	Observing a Swing	▨	▨						Observing/Questioning A-1.11 Complexity, diversity, intricacy I-C-2 Event properties, objects, space, time
2	Effect of Distance		▨	▨					Measuring/Manipulating Ideas A-2.14 Careful, systematic investigation I-C-2.6 Events, motion, space
3	Effect of Weight			▨	▨				Measuring/Manipulating Ideas, Acquiring Information A-2.13 Original insight, inferences I-C-2.2 Events, duration of time
4	Effect of Length				▨	▨			Measuring/Manipulating Ideas A-2.14 Careful, systematic investigation I-C-1.2 Object properties, place in space
5	Pendulum Objects					▨	▨		Observing/Acquiring Information-Listening, Reading B-1.2 Resourcefulness, innovativeness I-C-1 Object properties, material, condition

SUGGESTED APPROACH

Students can be exposed to pendulums through playground activity. While waiting for turns or as a follow-up to swinging, students can be engaged in discussion about swings.

Questions should be raised that can set the stage for further playground investigation or for classroom simulation of swings.

The activities can be conducted for varying amounts of time, depending on factors such as the number of students and length of playground time. Each student should be an active participant so that the feeling of the swing motion and effect of one's efforts to change the motion are direct experiences.

Study of applications of the pendulum principle can be an ongoing activity useful for reinforcement.

Special care should be taken to insure that students' use of playground swings is adequately supervised and conducted in a safe manner. This activity could provide an opportunity to teach safe use of swings in general.

MATERIALS

Access to playground swings
String (fish line)
Weights (metal washers)
Meter stick
Stopwatch or clock (wristwatch, or wall clock with sweep second hand)

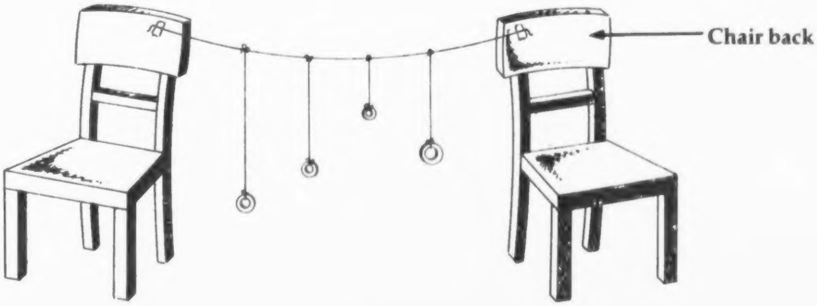
MORE IDEAS

1. Investigate the effect of using a solid (board, pipe, straw) in place of string, rope, or chain on a pendulum's motion.
2. Design a pendulum that will take a certain number of seconds to complete one swing. Build the pendulum and demonstrate the time.

   Supplemental information for teachers:

Time for One Swing	Approximate Length
1 second	1/4 meter (25 cm)
2 seconds	1 meter
3 seconds	2-1/4 meters (223 cm)
4 seconds	4 meters
5 seconds	6-1/4 meters (621 cm)
10 seconds	25 meters

3. Use a classroom pendulum to time various student activities, such as: completing a maze, doing a math problem, or finding words in a word search.
4. Observe the interaction between pendulums in a compound pendulum (two or more pendulums connected to a horizontal string tied between two supports). Vary the lengths and numbers of pendulums.
5. Investigate uses of the words "pendulum" and "swing" in our language, stories, or poetry.



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SYLLABUS EMPHASIS	ACTIVITIES	SUPPLEMENTARY INFORMATION
Problem: How does a swing move? Observing Questioning A-1.11 Complexity, diversity, intricacy I-C-2 Event properties, objects, space, time	**1. OBSERVING A SWING.** Provide students with access to a swing on the playground or simulated with pendulums in the classroom. Students participate in and observe the motion of the swing and describe their observations. Questions should be raised for later investigation such as: What would happen if more weight (people) were added? What would happen if the swing moved through a larger or smaller distance?	**Materials:** Playground swings OR String Weights Support Stopwatch **Safety Note:** Careful supervision is needed with playground swings.
Problem: Does the time for one full swing change with different distances (length of the arc)? Measuring/Manipulating Ideas A-2.14 Careful systematic investigation I-C-2.6 Events, motion, space	**2. EFFECT OF DISTANCE (LENGTH OF ARC).** Let students speculate about the effect of changing the size of the arc on the time for one full swing. Lead discussion to design experiments to test this speculation. An example could include pulling the swing with one student on board to various distances from rest and measuring the time for each full swing.	**Materials:** Playground swings OR Classroom pendulums Meter stick or tape Stopwatch **Safety Note:** Careful supervision is needed with playground swings.
Problem: Does the time for one full swing change with different weights? Measuring/Manipulating Ideas/Acquiring Information A-2.13 Original insight, inferences I-C-2.2 Event, duration of time	**3. EFFECT OF WEIGHT.** Let students speculate about the effect of weight on the time for one full swing. Lead discussion to design experiments to test their speculations. An example could include using a single playground swing and observing students from each grade swinging on the swing. Measure the time for one full swing (over and back).	**Materials:** Playground swings Students of various sizes (weights) Classroom pendulum Weights Stopwatch **Safety Note:** Careful supervision is needed with playground swings.
Problem: Does the time for one full swing change with different lengths of rope (chain or string)? Measuring/Manipulating Ideas A-2.14 Careful, systematic investigation I-C-1.2 Object properties, place in space	**4. EFFECT OF LENGTH.** Let students speculate about the effect of length of the support rope, chain, or string on the time for one full swing. Lead discussion to design experiments to test their speculations. An example could include using several swings of different lengths and having one student test each swing.	**Materials:** Playground swings Assistance to adjust the length of the swings OR Classroom pendulums Stopwatch **Safety Note:** Careful supervision is needed with playground swings.
Problem: What are some objects that are pendulums or that use pendulums? Observing/Acquiring Information B-1.2 Resourcefulness, innovativeness I-C-1 Object properties, material, condition	**5. PENDULUM OBJECTS.** Conduct a "pendulum hunt." Students can search the classroom, school building, or grounds; consult library books; browse magazines; or enlist the aid of others (parents, family, etc.). Discoveries can be described to the class and pictures or models displayed. Examples could include metronome, lawn furniture, circus trapeze, demolition ball.	**Materials:** Access to school building and grounds Library books Magazines

I

MYSTERY COLORS

"WHAT COLOR IS IT?"

MYSTERY COLORS – "WHAT COLOR IS IT?"

LEVEL I ________
(GRADE)

PROBLEM OVERVIEW

Children become aware of the phenomenon of mixing, creating new colors for example, through many activities in school, home, and elsewhere. New colors may have been created using food colors, water colors, paints, gelatin foods, crayons, chalk, or pencils.

The problem for the student in this mini-unit is to determine which colors were mixed to produce a "mystery color" and then create a replication of the color.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Emphasis
1	Making a Rainbow	▨	▨					Manipulating/Communicating Information A-2.25 Truthful reporting I-C-1.14 Mixtures
2	Separating Colors		▨					Replicating/Communicating Information B-1.1 Scientific techniques, materials I-C-1.14 Mixtures
3	Creating a Mystery Color			▨				Measuring/Recording Data A-2.14 Careful, systematic investigation I-C Objects, events, properties
4	Solving a Mystery Color				▨	▨	▨	Manipulating, Recording Data/ Communicating Information B-1.3 Technique, efficiency, simplicity, etc. I-C-2.3 Events, sequence, order, space

SUGGESTED APPROACH

Exposure to the problem could be established through any activity involving mixable colored substances (art, foods, etc.). Students could also be exposed to the problems through the premise of a game, "Mystery Colors." In this approach, students might be challenged to create a new color and keep the procedure and amounts secret. Each student's mystery color could become the color of the day to try to replicate. If students work in teams of three or four, the total number of colors can be kept to a manageable number, allowing all of the mystery colors to be done in a reasonable amount of class time.

MATERIALS

Paper towels
Dyes such as food coloring, water soluble markers, water soluble paints (tempera)
Clear plastic containers
Brushes
Crayons

MORE IDEAS

1. Visit a paint store to learn about paint mixing and matching.
2. Invite a painter or artist to the classroom to demonstrate color mixing.
3. Investigate the effects of other liquids on dye movement through towel paper. Examples: soap solution, rubbing alcohol, salt water, alcohol-water mixtures, cooking oil.
4. Create a real rainbow using sunlight and water sprayed from a hose.
5. Observe the colors in a natural rainbow after or during a rain shower.
6. Conduct a dye race. Determine which colors move fastest or the greatest distance along a long piece of toweling.
7. Create color rosettes by placing drops of dyes on a square piece of toweling, then adding water droplets.
8. Color eggs for seasonal activity.
9. Create a mystery color gelatin. Observe the effects of mixing flavors as well as colors.
10. Discuss color blindness and how this may affect color differentiation.

SYLLABUS EMPHASIS | **ACTIVITIES** | **SUPPLEMENTARY INFORMATION**

Problem:

What colors are needed to make a rainbow?

Manipulating/ Communicating Information	
A-2.25	Truthful reporting
I-C-1.14	Mixtures

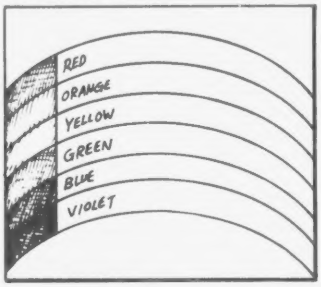
1. MAKING A RAINBOW.

Provide students with blue, red, and yellow tempera paints and other required materials to mix and paint on paper. By experimentation, students should paint a rainbow to match the predrawn colors using only the colors provided or mixtures of those colors.

Conduct a discussion to determine which combinations of paints were used to produce the needed colors.

Materials:

Tempera paints: blue, red, and yellow
Brushes
Plastic containers for paint and water
Paper with predrawn rainbow lines and sample colors
See illustration:



Problem:

How can mixed colors be separated?

Replicating/Communicating Information	
B-1.1	Scientific techniques, materials
I-C-1.14	Mixtures

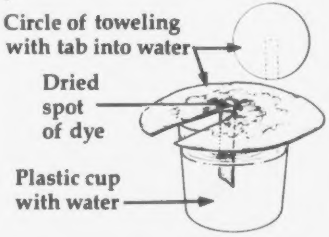
2. SEPARATING COLORS.

To demonstrate a suitable procedure for separating colors, use a paper chromatography process. Use a known mixed color such as green. See illustration at the right. Allow students to use the demonstration color and other known mixes (from Activity 1) to practice the procedure.

Conduct discussions to review the procedure, the results of its application, and modifications or changes to improve it.

Materials:

White paper toweling
Scissors
Plastic containers for water
Water soluble food coloring/egg dye



Problem:

Which colors must be used to create a mystery color?

Measuring/Recording Data	
A-2.14	Careful, systematic investigation
I-C	Objects, events, properties

3. CREATING A MYSTERY COLOR.

Provide students with access to materials needed to prepare mixes of colors. Challenge the students to prepare a "mystery color." The component colors and amounts used should be kept secret.

Examples of the mystery colors can be displayed in the classroom for interest.

Materials:

Construction paper
Coloring material: (food coloring/egg dye)
Plastic containers

Problem:

Which colors were used to create a mystery color?

Manipulating, Recording Data/Communicating Information	
B-1.3	Technique efficiency, simplicity, etc.
I-C-2.3	Events, sequence, order, space

4. SOLVING A MYSTERY COLOR.

Have students exchange "mystery color" samples. Provide the students with materials to conduct the color separation process.

Allow the students to conduct the analysis of the sample "mystery color."

Results can be shared as a group discussion or among individuals as the students attempt to solve the problem. Students can also attempt to replicate the mystery color based on their analysis.

Materials:

Sample mystery color from another student
Materials used in Activity 2

I

PETS

"WHAT DO THEY NEED TO LIVE AND BE HEALTHY?"

PETS – "WHAT DO THEY NEED TO LIVE AND BE HEALTHY?"

LEVEL I ______
(GRADE)

PROBLEM OVERVIEW

Many children have pets and show a great amount of interest in them. Other children may be interested in becoming pet owners. Animals' properties, habits, growth changes, and the care required for them to remain healthy are among the aspects of owning a pet that can raise questions for the owner or prospective owner. Students can learn more about specific animals, develop attitudes about caring for animals, and exercise some skills in seeking answers to questions about pets.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Emphasis
1	Animals Move	▨						Observing/Manipulating Ideas A-1.1 Appreciating natural world I-A-2.11 Wings, legs, fins
2	Animals Eat		▨					Observing, Recording Data/Manipulating Ideas A-1.1 Appreciating natural world I-A-2.12 Mouth, teeth, jaws, tongue
3	Animals Breathe			▨				Observing, Inferring/Manipulating Ideas A-1.1 Appreciating natural world I-A-2.13 Nostril
4	Animals Need Care				▨			Interpreting Data/Communicating Information B-2.1 Needs, problems of others I-A-2.5 Animals, control conditions, needs; I-B Plants, animals, dependency; I-B-3
5	Animals React					▨		Observing, Identifying Variables/Manipulating Ideas A-1.1 Appreciating natural world I-A-2.2 Animal parts, immediate needs
6	Playing Safely With Animals						▨	Generalizing/Communicating Information A-1.2 Respecting life; A-2.21 Safety I-A Plants, animals, needs

SUGGESTED APPROACH

Activities to seek answers to questions about pets can be conducted in various sequences and for varying amounts of time, depending on student interest and the kinds of pets available for study. It may be desirable in some classroom settings to conduct activities on consecutive days. In other classroom settings a day or two per week could be set aside for "Pet Time." Local conditions will dictate which approach will be most appropriate for conducting the activities.

Draw upon the students' experiences with pets to raise questions that can be used to teach animal properties, activities, and care. Students can bring in photographs or draw a picture of their pets. Those students without a pet can "adopt" one or choose one they would like to own.

Permit students to bring a few live pets to school for class study. These pets should be caged or confined for safety purposes. Appropriate clearances from school officials and parental permissions must also be obtained in advance. Students can observe a pet for a period of time and record observations. The observations can be sequenced according to the accompanying activities.

To assist in classroom management, it may be desirable to limit the pets to one at a time. In the event pets are not readily available from home, it may be possible to have a pet store bring in pets for one or more days to show and discuss.

Following completion of all activities, any extended activities, and discussion of the results, individual or group reports can be made in the form of a "book" about pets such as "My Pet – What It Needs to Live and Be Healthy."

MATERIALS

Live pet or pets – can be supplied by students or loaned to class

Cage, pens, tanks, etc., to serve as a confinement home

Food (appropriate for each kind of pet)

Print and nonprint material relating to the activities

MORE IDEAS

1. Develop a long-term investigation to answer questions such as:

- How does the pet's body covering change from season to season?
- How does the pet change as it grows from infancy to adulthood?
- How does the pet keep warm in cool weather and cool in warm weather?

2. Help students synthesize rules for caring for a new pet.

3. Let students simulate an animal's motions, method of eating, etc., and have others guess which animal is being imitated.

4. Visit a zoo, farm, commercial pet shop, or other area where animals are kept to observe the animals' activity.

5. Help students conduct a survey of other children or adults with such questions as:

- Why do people like pets?
- Which animal is the favorite pet?
- Which animal is the most unusual pet?
- Which animal is the smallest pet?
- Where do pets come from?

6. Discuss how domesticated animals have other functions such as seeing eye dogs or hearing ear dogs.

SYLLABUS EMPHASIS	ACTIVITIES	SUPPLEMENTARY INFORMATION
Problem: How does the pet move? Observing/Manipulating Ideas A-1.1 Appreciating natural world I-A-2.11 Wings, legs, fins	**1. ANIMALS MOVE.** Provide students with access to a living pet animal and allow observations to be made of its means of movement. Conduct a class discussion of the problem and the observations. Students can be helped to develop summarizing statements to conclude the activity.	**Materials:** Live pet animal Print and nonprint materials relating to animal locomotion
Problem: What, when, and how does the pet eat and drink? Observing, Recording Data/ Manipulating Ideas A-1.1 Appreciating natural world I-A-2.12 Mouth, teeth, jaws, tongue	**2. ANIMALS EAT.** Let students share their knowledge of what the pet eats and how and when it eats. Lead the students to develop questions about variations in types of food the pet might eat, schedules for eating, or how the pet might eat a certain kind of food. Provide the materials needed to test for answers to the questions. Record data for various kinds of food, times, and eating methods used by the pet. Conduct a discussion of the questions and the results of the experimentation. Summarizing statements can be developed to conclude the activity.	**Materials:** Live pet or pets Various kinds of food
Problem: How does the pet breathe? Observing, Inferring/ Manipulating Ideas A-1.1 Appreciating natural world I-A-2.3 Nostril	**3. ANIMALS BREATHE.** Provide students with access to a living pet animal and allow observations to be made of its means of breathing. Conduct a class discussion of the problem and observations. Students can be helped to develop summarizing statements and inferences to conclude the activity.	**Materials:** Live pet Print and nonprint materials relating to animal breathing
Problem: How does the pet take care of itself and what care must it be given? Interpreting Data/ Communicating Information B-2.1 Needs, problems of others I-A-2.5 Animals, control conditions, needs I-B Plants, animals, dependency (I-B-3)	**4. ANIMALS NEED CARE.** Provide students with access to a living pet animal and allow observations to be made in search of evidence of self-care. Record the results of observations. Let students share their knowledge of the care that must be given to a pet by an owner. Conduct a discussion of the proper methods of providing the care. Let the students practice giving the care to the pet, and make observations of the results. Conduct a discussion of the problem and the results of the activity. Summarizing statements can be made describing the details and sequence of activity involved in providing care for the pet.	**Materials:** Live pet Print material relating to care needed for pets

SYLLABUS EMPHASIS
Cont'd

ACTIVITIES
Cont'd

SUPPLEMENTARY INFORMATION
Cont'd

Problem:

How can you tell when the pet is excited, frightened, or injured?

Observing, Identifying Variables/Manipulating Ideas	
A-1.1	Appreciating natural world
I-A-2.2	Animal parts, immediate needs

5. ANIMALS REACT.

Let students share their knowledge of evidence that animals are excited, frightened, or injured. Factors which can cause the reactions can be identified by the students.

Conduct a discussion about the causes and effects that can lead to the pet reactions and pet owner responsibility. Help the students develop some suggested experiments to test causes for excitement in the pet. Provide controlled access to the pet and allow the suggested experiments to be performed.

Conduct a discussion of the problem and observations of the results of the experimentation. Summarizing statements can be developed to conclude the activity.

Materials:

Live pet
Print and nonprint material relating to animal reactions

Problem:

How do you play with the pet safely?

Generalizing/Communicating Information	
A-1.2	Respecting life
A-2.21	Safety
I-A	Plants, animals, needs

6. PLAYING SAFELY WITH ANIMALS.

Let students share their knowledge and experiences of playing with their pets. Discuss cause and effect of various kinds of play that are suggested. Lead students to review the needs of the pet and how play can be related to helping the animal meet its needs.

Help students summarize the outcomes of the discussion by describing the details of safely playing with a pet.

A concluding report in the form of a class "book" or individual book can be produced to illustrate the outcomes of the activities of the unit.

Materials:

Print and nonprint materials about safety with pets

I EARTHWORMS

EARTHWORMS

LEVEL I ______
(GRADE)

PROBLEM OVERVIEW

The common earthworm, or night crawler, is an animal familiar to many children. However, most children have probably never looked closely enough at an earthworm to notice how it moves, eats, and lives or to notice the details of its body parts and its effect on the surrounding soil. The familiar yet unknown aspects about earthworms can be used to arouse the students' curiosity and may lead to a number of questions to investigate.

SUGGESTED SCHEDULE/SYLLABUS EMPHASIS

#	Activity Title	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Emphasis
1	Body Parts of Earthworms	▨	▨						Observing/Communicating Information A-1.11 Complexity, diversity, intricacy I-A-2 Animals, properties, needs
2	Movement of Earthworms	▨	▨						Generalizing/Manipulating Ideas A-2.23 Contributing fair share of effort I-A-2.1 Animal parts, functions
3	Habitat of Earthworms			▨	▨	▨			Inferring/Manipulating Ideas A-1.33 Explanation, interpretation, prediction I-A-2.5 Animals, control conditions, needs
4	Food Intake of Earthworms				▨	▨			Inferring/Manipulating Ideas A-2.25 Truthful reporting I-B Plants, animals, dependency
5	Earthworm Effect on Soil						▨		Observing/Communicating Information A-2.14 Careful, systematic investigation I-A-2.5 Animals, control conditions, needs
6	Living Things Depend on Earthworms							▨	Interpreting Data/Acquiring Information A-1.32 Accurate information I-B-1 Plants – animals

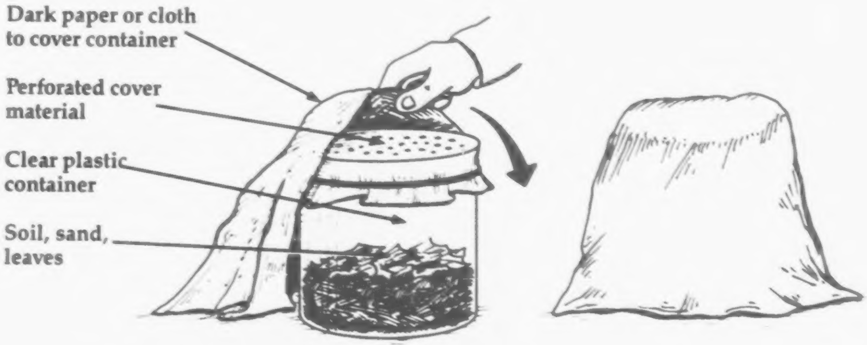
SUGGESTED APPROACH

Earthworms can be obtained by collecting them in the evening (after a rain is best) in a garden or lawn area. This could become a homework task assisted by parents. Earthworms can also be purchased from commercial sources such as bait shops, pet stores, or science supply houses.

Students should construct a classroom home or habitat for their earthworms in a clear, wide-mouth container. Soil, sand, and some decaying leaves should be arranged in alternating layers in the container and moistened before adding the earthworms. Each habitat should contain two earthworms. A cover consisting of material perforated to allow air to enter should be used to cover the container mouth. The entire container should be covered with dark cloth or paper and placed in a cool dark place. The soil should be kept moist by watering when needed. (See illustration below.)

Students should identify questions they want to answer about earthworms and then plan for the best way to collect information to help answer the questions.

The activities in this mini-unit represent one sequence useful to obtain experience with earthworms that can lead to new knowledge and attitudes about the unique animal, the earthworm. At the conclusion of the activities the earthworms and soil material can be returned to the natural environment.


Dark paper or cloth to cover container
Perforated cover material
Clear plastic container
Soil, sand, leaves

MATERIALS

Clear container with wide mouth, such as cut-off plastic two-liter soda bottles, or round or rectangular clear plastic food storage containers
Soil
Sand
Decayed leaves, compost material, or peat moss
Earthworms (one to two per student)
Dark paper or cloth (to cover jar)
Lettuce, radish seeds, or other bits of food material
Magnifiers
Material to cover container top, perforated

MORE IDEAS

1. Investigate whether earthworms make noises.
2. Determine whether the number of segments changes with size of earthworms.
3. Determine what conditions cause the earthworm to stretch (lengthen) or contract (shorten).
4. Determine whether earthworms go into their tunnels or burrows front end first or rear end first.
5. Have students act out the movements of an earthworm.
6. Have students draw simple pictures of the earthworms that show major body parts.
7. Have students make a written report of the observations of earthworms.

SYLLABUS EMPHASIS	ACTIVITIES	SUPPLEMENTARY INFORMATION
Problem: What body parts are observable on earthworms? Observing/Communicating Information A-1.11 Complexity, diversity, intricacy I-A-2 Animals, properties, needs	**1. BODY PARTS OF EARTHWORMS.** Provide students with access to a live earthworm and allow observations to be made while looking for body parts. Students can carefully handle the animal and inspect it with a magnifier. Conduct a discussion of observations.	**Materials:** Live earthworm (one per one or two students) Magnifiers **Procedural Note:** This activity can be done simultaneously with Activity 2 over two or more class periods.
Problem: How does an earthworm move? Generalizing/Manipulating Ideas A-2.23 Contributing fair share of effort I-A-2.1 Animal parts, functions	**2. MOVEMENT OF EARTHWORMS.** Provide students with access to a live earthworm and allow observations to be made of earthworm motion. Conduct discussion to obtain descriptions of the movement, and compare it to other animals such as snakes or mealworms.	**Materials:** Live earthworms
Problem: How does an earthworm build its home? Inferring/Manipulating Ideas A-1.33 Explanations, interpretations, predictions I-A-2.5 Animals, control conditions, needs	**3. HABITAT OF EARTHWORMS.** Provide students with access to the clear container habitat containing live earthworms. Allow students to observe earthworm activity and seek answers to questions such as "How does an earthworm dig a tunnel?" If possible, conduct a field trip to a natural area populated by earthworms and seek additional evidence of how earthworms establish their habitat. Conduct a discussion to summarize findings.	**Materials:** Live earthworms Classroom habitat for earthworms Access to a natural habitat for earthworms Magnifiers
Problem: What do earthworms eat? Inferring/Manipulating Ideas A-2.25 Truthful reporting I-B Plants, animals, dependency	**4. FOOD INTAKE OF EARTHWORMS.** Provide students with small bits of various food material to be placed on the soil surface in the earthworm habitat. Allow students to make observations from time to time to seek evidence of any eating by earthworms. Conduct a discussion to summarize findings.	**Materials:** Earthworms and habitat Small bits of food material such as lettuce, leaves, seeds Magnifiers

SYLLABUS EMPHASIS Cont'd	ACTIVITIES Cont'd	SUPPLEMENTARY INFORMATION Cont'd
Problem: What effect do earthworms have on soil material? Observing/Communicating Information A-2.14 Careful, systematic investigation 1-A-2.5 Animals, control conditions, needs	**5. EARTHWORM EFFECT ON SOIL.** After sufficient time for earthworms to have had an effect on soil, allow students to carefully remove the earthworms from the habitat and return them to a natural environment. Students should carefully remove the soil material or cut away the container to keep the soil habitat intact. The soil material can then be carefully pulled apart or cut apart to look for evidence of change. Conduct a discussion to summarize findings.	**Materials:** Earthworms and habitat Sheets of newspaper Shears
Problem: How do other living things benefit from earthworms? Interpreting Data/Acquiring Information A-1.32 Accurate information 1-B-2 Plants – animals	**6. LIVING THINGS DEPEND ON EARTHWORMS.** Have students share prior experiences with earthworms to obtain evidence of dependency of living things on earthworms. Provide students with access to literature to search for additional evidence of dependency. Conduct a concluding discussion to bring together students' experiences from all of the activities relating to dependency.	**Materials:** Results from Activities 1-5 Access to print and nonprint material on earthworms

I

UNIT STARTERS

UNIT STARTERS

LEVEL I ________
Grade Level

Grade Level	Syllabus Connection	Focus Question	Problem Overview
☐	Identifying Variables/ Active Reading, Listening A-2.11 I-D-3.2	What makes a balloon go up?	Some balloons go up when released (helium filled), some do not go up (air filled from lungs). Some large balloons rise when filled with hot air. This unit can focus on identifying factors which seem to determine whether a balloon will rise.
☐	Measuring/ Questioning A-2.14 I-D-1.2, 1.3	At which temperature does butter (margarine) melt?	On a hot day children may have observed a dish containing melted butter left unrefrigerated. Other days the same butter remains solid when unrefrigerated. Which temperature is the critical temperature to keep the butter solid? Is it the same for all brands?
☐	Measuring/Communicating Information A-2.11 I-C-1.11	Which liquid is most viscous (thickest)?	Students may be aware of ads for the "slowest" catsup, tomato sauce, or shampoo. The property of viscosity (thickness) seems to vary from one liquid product to another.
☐	Predicting/Communicating Information A-1.33 I-C-1.2/I-C-2.6	Where will the moon be tomorrow?	At a time when both the sun and moon can be seen in the sky the discrepancy may be noted by students that this observation cannot be made every day. Developing a prediction for an expected observation can become the central problem to be solved.
☐	Formulating Hypotheses/ Communicating Information A-2.12 I-C-1/I-C-2	How do you find something that is lost?	Misplacing an object can be a frustrating experience for anyone, particularly a child. Exploring systematic procedures to help retrieve the misplaced object focuses the problem-solving activity.
☐	Observing/Communicating Information A-1.11 I-C-1.11	Are all rocks, pebbles, or stones the same?	Loose rocks, pebbles, or stones collected by students on excursions can focus attention on similar or dissimilar properties of objects. Students can become aware of some detail of rock materials while trying to solve the problem.
☐	Measuring/Questioning A-1.31 I-C-2.5	When does noon occur?	The time of day, noon, is a unique event. Students becoming aware of the term, noon, may wonder how it is determined, or what it is.
☐	Measuring/Questioning A-1.3 I-C-1.5	Where in the room is the air warmest?	During a cold season interest might be high in keeping warm. Students can initiate a search for the warmest "spot" or location in the room.

UNIT STARTERS

LEVEL I ____________
Grade Level

Grade Level	Syllabus Connection	Focus Question	Problem Overview
☐	Observing/Communicating Information A-2.24 I-A-2.11/I-A-2.7	How do fish move through the water?	Careful observations of fish in their habitat can arouse the curiosity of students about how the fish swim and the function of fins.
☐	Using Numbers/ Questioning A-1.11 I-A-1.1/I-C-1	Do all pumpkins have the same number of seeds?	Carving a pumpkin to make a Jack-O-Latern can raise many questions about pumpkins, each of which can lead to activities. The number of seeds is one such question that can be pursued.
☐	Observing/Questioning A-1.11 I-A-1.5/I-C-1.3	Are all the leaves on a tree alike?	Observing the first falling leaves in autumn and awareness of the large number of leaves on a given tree can lead to many questions to pursue. Students may have to decide how leaves are alike and different.
☐	Formulating Hypotheses/ Questioning A-1.33 I-A-2.3	How does an animal's appearance change during a period of time such as the fall?	Observing the seasonal activity of animals may lead to an awareness that the animals change in appearance with the seasonal change. Questions may arise relating to the kinds of changes, when they begin, and differences from one animal to another.
☐	Generalizing/Acquiring Information/Listening A-2.11 I-B-1	How many different ways do people depend on plants?	Awareness that people depend on plants in usual ways (food) may lead to interest in finding other more unusual ways.
☐	Inferring/Questioning A-2.13 I-A-2.7/I-B	What kinds of food do birds like to eat?	Access to an outside bird feeder for observations can lead to many questions and problems to solve about food preferences among birds. Various types of foods can be tested and compared on the birds that frequent the feeder.
☐	Interpreting Data/ Using Cues A-1.11 I-A-1/I-B-1	Which foods that we eat are seeds, or are made directly from seeds?	Becoming aware that seeds contain stored food, and are eaten as food by many animals can lead to a search for seed foods for humans. Sampling new foods is a natural extension of this problem.
☐	Generalizing/Recording Data A-2.11 I-A-2	Which animal characteristics or behaviors are myths?	Some alleged animal characteristics or behaviors may be myths. Identifying the characteristics and behaviors and seeking to separate fact from myth establishes the problem. Examples such as goats eating tin cans; snakes feeling slimy and wet, or able to jump; or cats able to see in the dark are but a few for consideration.

APPENDICES

APPENDIX A

Students with Handicapping Conditions

The Board of Regents, in revising the Part 100 Regulations of the Commissioner, has made a strong commitment to integrating the education of students with handicapping conditions into the total school program. According to Section 100.2(s) "Each student with a handicapping condition, as such term is defined in Section 200.1(ii) of this Chapter, shall have access to the full range of programs and services set forth in this Part to the extent that such programs and services are appropriate for each student's special educational needs." Districts must have policies and procedures in place to make sure that students with handicapping conditions have equal opportunities for access to diploma credits, courses and requirements.

The majority of students with disabilities have the potential intellectual capacity to master the curricula content requirements for a high school diploma. Most students who require special education attend regular education classes in conjunction with specialized instruction and/or related services. These students must attain the same academic standards as their nonhandicapped peers in order to meet these requirements. For this reason, it is very important that at all grade levels students with handicapping conditions receive instruction in the same content areas so as to receive the same informational base that will be required for proficiency on statewide testing programs and diploma requirements.

It is important that teachers providing instruction through this syllabus be familiar with how the process of special education is implemented. This appendix will provide clarification as to how students with handicapping conditions participated in both regular and special education programs. The coordination and integration of both of these programs is essential for the benefit of all students.

Providing Special Education

Students who are educationally handicapped are those students who are referred to the Committee on the Handicapped (COH) as suspected of having a handicapping condition. A written referral is submitted to the COH which then must proceed to conduct a comprehensive individual evaluation. This evaluation is a comprehensive assessment which is used by the COH to determine whether the student has a handicapping condition which adversely affects the student's educational performance. If the Committee on the Handicapped determines that the student is eligible for special education, the COH and the student's parents develop an individualized educational program (IEP). This recommendation must include:

- present levels of performance and individual needs according to the four criteria areas of academic, social and physical development and management needs;
- classification of the handicapping condition;
- annual goals;
- recommended program, class size, and extent of participation in regular education;
- project date for initiation of special education, amount of time per day, and projected review date;
- specialized equipment and adaptive devices;
- testing modifications; and
- recommended placement.

Following the COH recommendation, the Board of Education (BOE) has 30 school days to arrange for implementation. After the student enters the program, a planning conference is held to complete the development of the individualized educational program by adding short-term objectives and objective criteria and evaluation procedures for determining whether the instructional objectives are met. The student's program is reviewed at least annually, and the student receives a comprehensive reevaluation at least every three years.

The entire process has corresponding time lines and due process procedures for each step.

As the Committee on the Handicapped makes its recommendation for appropriate programs and placements, careful consideration is given to the concept of the least restrictive environment. The concept of least restrictive environment has three key components:

- Special education needed by the pupil – This means that the recommended program of a handicapped pupil must meet his or her individual needs. This ensures that any placement into either special or regular education programs must be appropriate. If a student is recommended for participation in a regular education setting, then the student should have abilities which would allow that student to benefit from such instruction.
- Participation with nonhandicapped peers to the maximum extent appropriate – Consideration of this component ensures the integration of handicapped students with their nonhandicapped peers, whenever appropriate to their individual needs.
- Proximity to the pupil's place of residence – Consideration of this component maximizes the potential interaction with other students in the home school area.

The concept of least restrictive environment is important for all educators to understand. Its intent is to include handicapped students into the total educational system whenever possible, but it also ensures that such placements must be appropriate. Therefore, any placements that would seem to be inappropriate should constitute a referral back to the COH for review.

The teacher providing instruction through this syllabus has the opportunity to provide an educational setting which will enable the student to explore his or her abilities and interests. Instruction could be provided to handicapped students either by teachers certified in this subject area or by special education teachers. Teachers certified in this subject area would be providing instruction to handicapped students recommended by the COH as being able to benefit from instruction in a regular educational setting. Special

(Cont'd)

education teachers may also provide this instruction to a class of students with handicapping conditions in a special class setting.

Teachers certified in the subject area should become aware of the needs of those students with handicapping conditions participating in their classes. Instructional techniques and materials must be modified to the extent appropriate to provide students with handicapping conditions the opportunity to meet diploma requirements. Information or assistance is available through special education teachers, administrators, the Committee on the Handicapped or the student's IEP.

Special education teachers providing this instruction must also become familiar with the goals and objectives of the curriculum. It is important that these teachers provide their students with the same equivalent information contained in the curriculum.

Regardless of who provides the instruction, the cooperation between regular and special education programs is essential. It is important for the students as well as the total school environment.

Another consideration in assisting students with handicapping conditions to meet the requirements of regular education is the use of alternative testing techniques. Handicapped students may be provided alternative testing techniques on statewide tests and district testing programs. The consistent use of alternative testing techniques is important for providing handicapped pupils the opportunity to demonstrate their knowledge and skills without being limited by their handicapping conditions.

The coordination and cooperation of the total school program will assist in providing the opportunity for a greater number of handicapped students to meet the requirements needed to pursue a high school diploma. The integrated provision of regular education programs, special education programs, remediation, alternative testing techniques, modified teaching techniques and materials, and access to credit through alternatives will assist in enabling such students to pursue the high school diploma to a greater degree. The teacher who provides instruction through this curriculum has a unique opportunity to assist such students in their individual goals.

APPENDIX B

SYLLABUS - PROGRAM CORRELATION CHART
LEVEL I

		Time Emphasis (Days)	ACTIVITIES														
INQUIRY SKILLS	CLASSIFYING																
	CREATING MODELS																
	FORMULATING HYPOTHESES																
	GENERALIZING																
	IDENTIFYING VARIABLES																
	INFERRING																
	INTERPRETING DATA																
	MAKING DECISIONS																
	MANIPULATING MATERIALS																
	MEASURING																
	OBSERVING																
	PREDICTING																
	RECORDING DATA																
	REPLICATING																
	USING NUMBERS																
LANGUAGE ARTS SKILLS/ PROCESSES	CLASSIFYING																
	DEVELOPING VOCABULARY																
	MANIPULATING IDEAS																
	QUESTIONING																
	RECORDING DATA																
	USING CUES																
	ACQUIRING INFORMATION																
	COMMUNICATING INFORMATION																
SCIENCE ATTITUDES	A. APPRECIATING, ENJOYING, NATURE																
	1. UNDERSTANDING, NATURAL WORLD																
	1.1 APPRECIATING NATURAL WORLD																
	1.11 COMPLEXITY, DIVERSITY, INTRICACY, ETC.																
	1.12 RESOURCE, HUMAN NEEDS																
	1.2 RESPECTING LIFE																
	1.21 INDIVIDUAL LIFE, PRECIOUS																
	1.22 SOURCE FOR CONTINUATION																
	1.23 AGING PROCESS																
	1.3 WANTING TO KNOW, UNDERSTAND																
	1.31 CONCEPTS, TERMS, TECHNIQUES, ETC.																
	1.32 ACCURATE INFORMATION																
	1.33 EXPLANATIONS, INTERPRETATIONS, PREDICTIONS																
	2. INVESTIGATIVE METHODS, NATURAL WORLD																
	2.1 SKEPTICISM, INVESTIGATION, REASONING																
	2.11 UNCERTAINTY OF INFORMATION, VERIFICATION																
	2.12 AMBIGUITY, CONTRADICTION, TENTATIVENESS																
	2.13 ORIGINAL INSIGHT, INFERENCES, ETC.																
	2.14 CAREFUL, SYSTEMATIC INVESTIGATION																
	2.15 LOGICAL REASONING, VALIDITY OF IDEAS																
	2.2 RESPECTING OTHERS, ENVIRONMENT																
	2.21 SAFETY																
	2.22 USE OF RESOURCES																
	2.23 CONTRIBUTING FAIR SHARE OF EFFORT																
	2.24 CONTRIBUTIONS, OTHERS																
	2.25 TRUTHFUL REPORTING																
	2.26 BELIEFS AND VALUES OF OTHERS																
	B. VALUING USE OF KNOWLEDGE FOR SOCIETY																
	1. THE PRACTICAL, TECHNICAL																
	1.1 SCIENTIFIC TECHNIQUES, MATERIALS																
	1.2 RESOURCEFULNESS, INNOVATIVENESS																
	1.3 TECHNIQUE EFFICIENCY, SIMPLICITY, ETC.																
	2. SERVICE THROUGH TECHNOLOGY																
	2.1 NEEDS, PROBLEMS OF OTHERS																
	2.2 BENEFITS OF TECHNOLOGICAL CHANGE																
	2.3 POTENTIAL ADVERSE CONSEQUENCES																

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LIFE SCIENCE (LEVEL I)	I. NATURAL WORLD																
	IA. PLANTS, ANIMALS, NEEDS																
	1. PLANTS, PROPERTIES, NEEDS																
	1.1 PLANT PARTS, FUNCTIONS																
	1.11 ROOTS																
	1.12 LEAVES																
	1.13 STEMS, STALKS, TRUNKS, ETC.																
	1.2 PLANT PARTS, IMMEDIATE NEEDS																
	1.3 PLANT PARTS, SEASONAL CHANGES																
	1.4 PLANT GROWTH AND DEVELOPMENT, LIFE SPAN																
	1.41 SEED, SEEDLING, MATURE PLANT																
	1.42 BULB, YOUNG PLANT, MATURE PLANT																
	1.43 LENGTH OF LIFE SPAN																
	1.5 PLANT PART VARIATIONS																
	2. ANIMALS, PROPERTIES, NEEDS																
	2.1 ANIMAL PARTS, FUNCTIONS																
	2.11 WINGS, LEGS, FINS																
	2.12 MOUTH, TEETH, JAWS, TONGUE																
	2.13 NOSTRIL																
	2.14 EYES, NOSE, EARS, TONGUE, SKIN																
	2.15 CLAWS, SHELLS, ETC.																
	2.16 BODY COVERING																
	2.17 PARTS, SOUND																
	2.2 ANIMAL PARTS, IMMEDIATE NEEDS																
	2.3 ANIMAL PARTS, SEASONAL NEEDS																
	2.4 ANIMAL GROWTH AND DEVELOPMENT, LIFE SPAN																
	2.41 YOUNG TO ADULT STAGES																
	2.42 LENGTH OF LIFE SPAN																
	2.5 ANIMALS, CONTROL CONDITIONS, NEEDS																
	2.6 ANIMALS, MOTION, NEEDS																
	2.7 ANIMAL PART VARIATIONS																
	IB. PLANTS, ANIMALS, DEPENDENCY																
	1. ANIMALS — PLANTS																
	2. PLANTS — ANIMALS																
	3. ANIMALS — ANIMALS																
PHYSICAL SCIENCE (LEVEL I)	IC. OBJECTS, EVENTS, PROPERTIES																
	1. OBJECT PROPERTIES, MATERIAL, CONDITION																
	1.1 OBJECT PROPERTIES, MATERIAL																
	1.11 DIFFERENT MATERIALS/PROPERTIES																
	1.12 CHANGING SIZE, SHAPE																
	1.13 SOLID, LIQUID, GAS																
	1.14 MIXTURES																
	1.2 OBJECT PROPERTIES, LOCATION IN SPACE																
	1.3 OBJECT PROPERTIES, AMOUNT OF SPACE																
	1.4 TWO OBJECTS, SAME SPACE																
	1.5 OBJECT PROPERTIES, SURROUNDING CONDITIONS																
	2. EVENT PROPERTIES, OBJECTS, SPACE, TIME																
	2.1 EVENT, TIME, PLACE IN SPACE																
	2.2 EVENT, DURATION OF TIME																
	2.3 EVENTS, SEQUENCE, ORDER, SPACE																
	2.4 TWO EVENTS, TIME																
	2.5 REPEATING EVENTS, INTERVALS OF TIME																
	2.6 EVENTS, MOTION, SPACE																
	ID. INTERACTION, OBJECTS, EVENTS																
	1. OBJECTS — HEAT																
	1.1 HEATING, COOLING, WARMER, COLDER																
	1.2 HEATING MATERIALS, LIQUIDS, GASES																
	1.3 COOLING MATERIAL, LIQUIDS, SOLIDS																
	1.4 HEATING, COOLING, VOLUME CHANGE																
	2. OBJECT, MOTION, PUSH-PULL																
	2.1 DIRECTION OF PUSH-PULL, CHANGE IN MOTION																
	2.2 SIZE OF PUSH-PULL, OBJECT MASSIVENESS, MOTION																
	2.3 SURFACE CONDITION, SIZE OF PUSH-PULL, MOTION																
	3. OBJECTS, SUPPORTED BY OBJECTS																
	3.1 UNIFORM BALANCE BEAM																
	3.11 TWO OBJECTS, EQUAL WEIGHT, BALANCE POINT																
	3.12 TWO OBJECTS, DIFF. WEIGHT, BALANCE POINT																
	3.2 OBJECTS, FLOATING, SINKING																

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